United States Patent

[11] 3,613,741

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[73] Assignee **Boris Kroll Jacquard Looms, Inc.**
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[54] **SHUTTLELESS LOOM**
18 Claims, 37 Drawing Figs.

[52] **U.S. Cl.** ..... **139/127 R,** 139/54, 139/122 N, 139/122 S
[51] **Int. Cl.** **D03d 47/18**
[50] **Field of Search** 139/122–127, 54

[56] **References Cited**
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Primary Examiner—Henry S. Jaudon
Attorney—Amster & Rothstein

ABSTRACT: A shuttleless loom having two filling thread carriers which move inwardly from the opposite sides of the weaving section of the loom to a medial filling thread transfer location, with one thread carrier being arranged to pick up a selected filling thread from one of a plurality of a relatively fixed thread supplies and transport the selected filling thread to the medial transfer location and with the other thread carrier being arranged to pick up the filling thread from the first carrier and complete the filling.

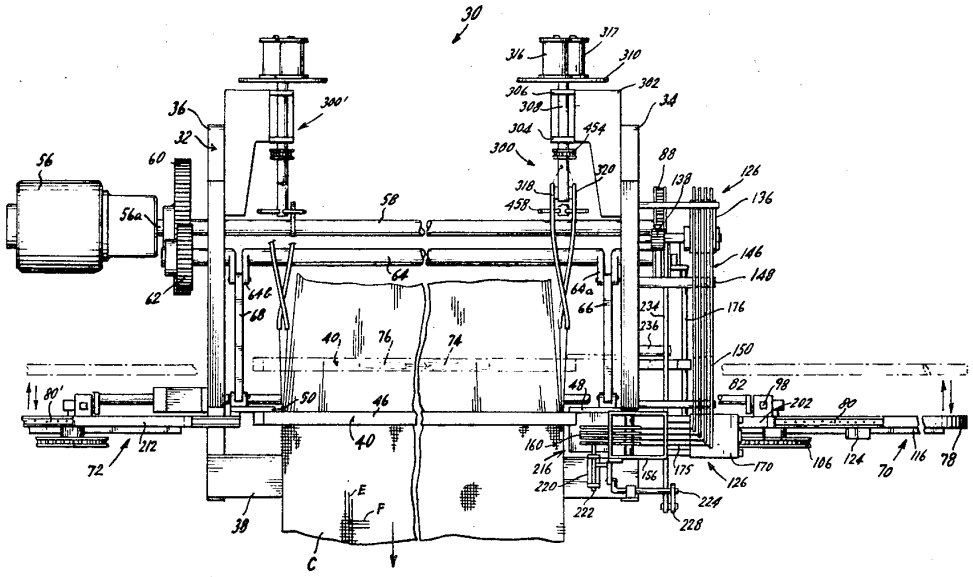

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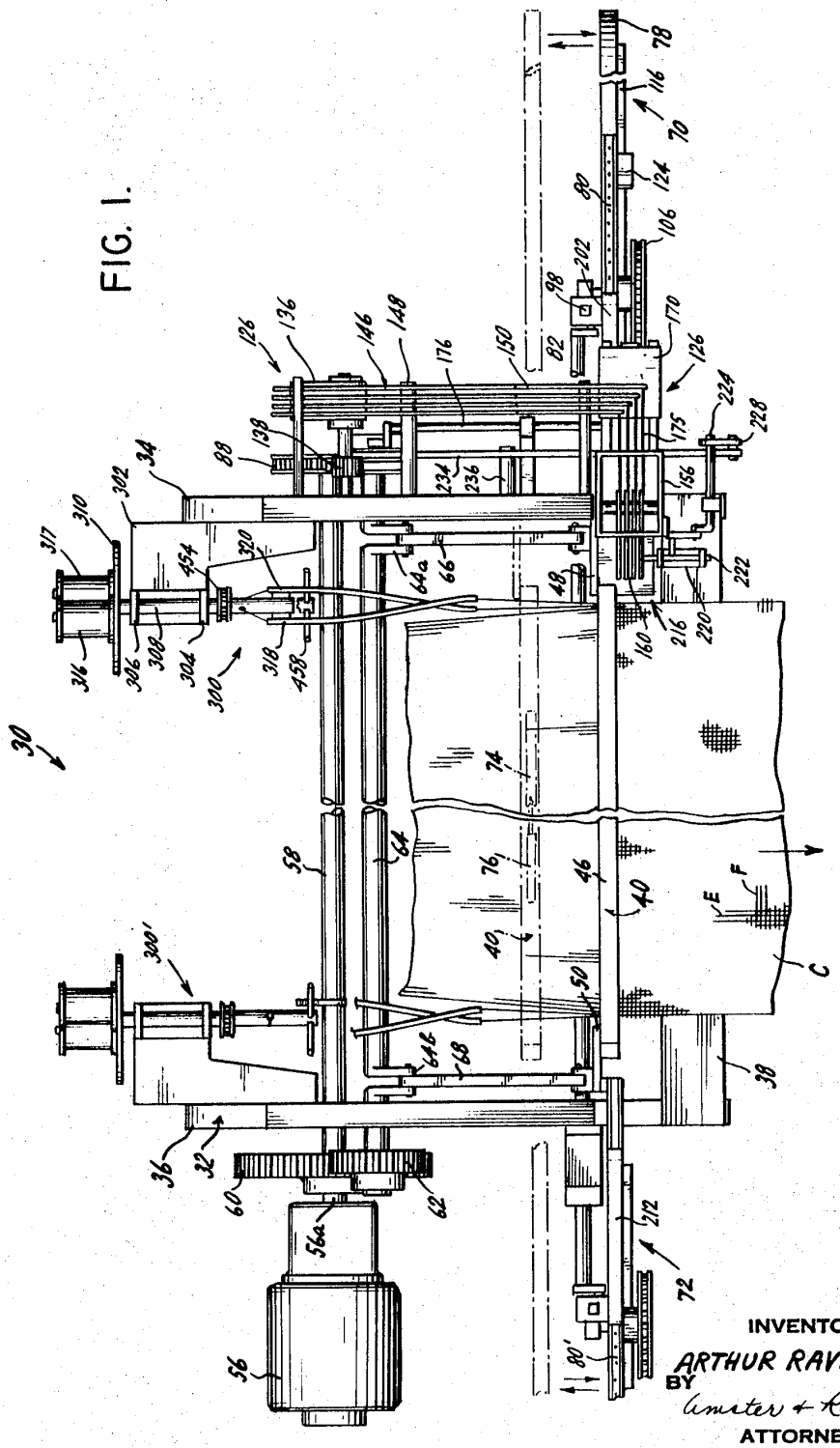
FIG. 1.



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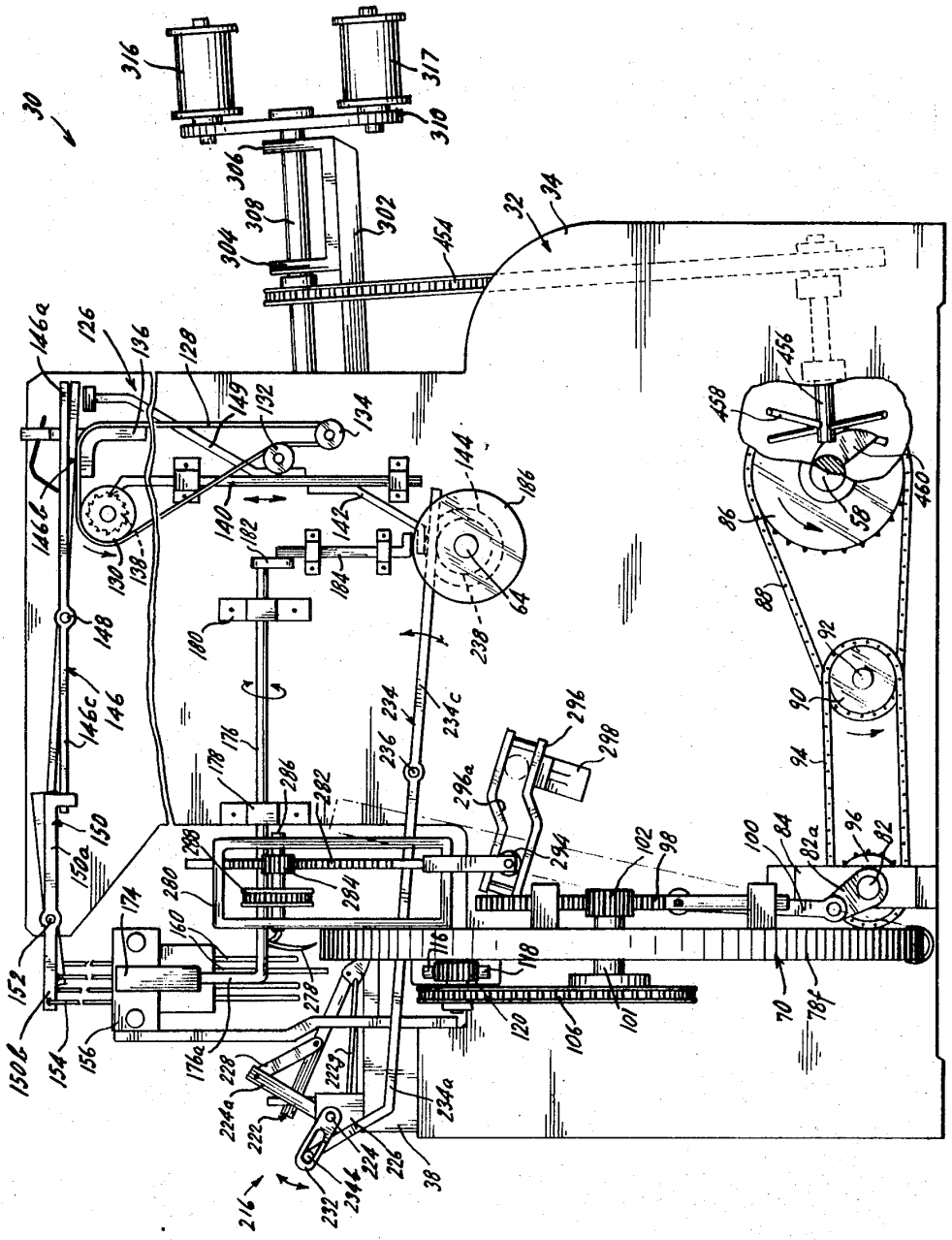

FIG. 2.

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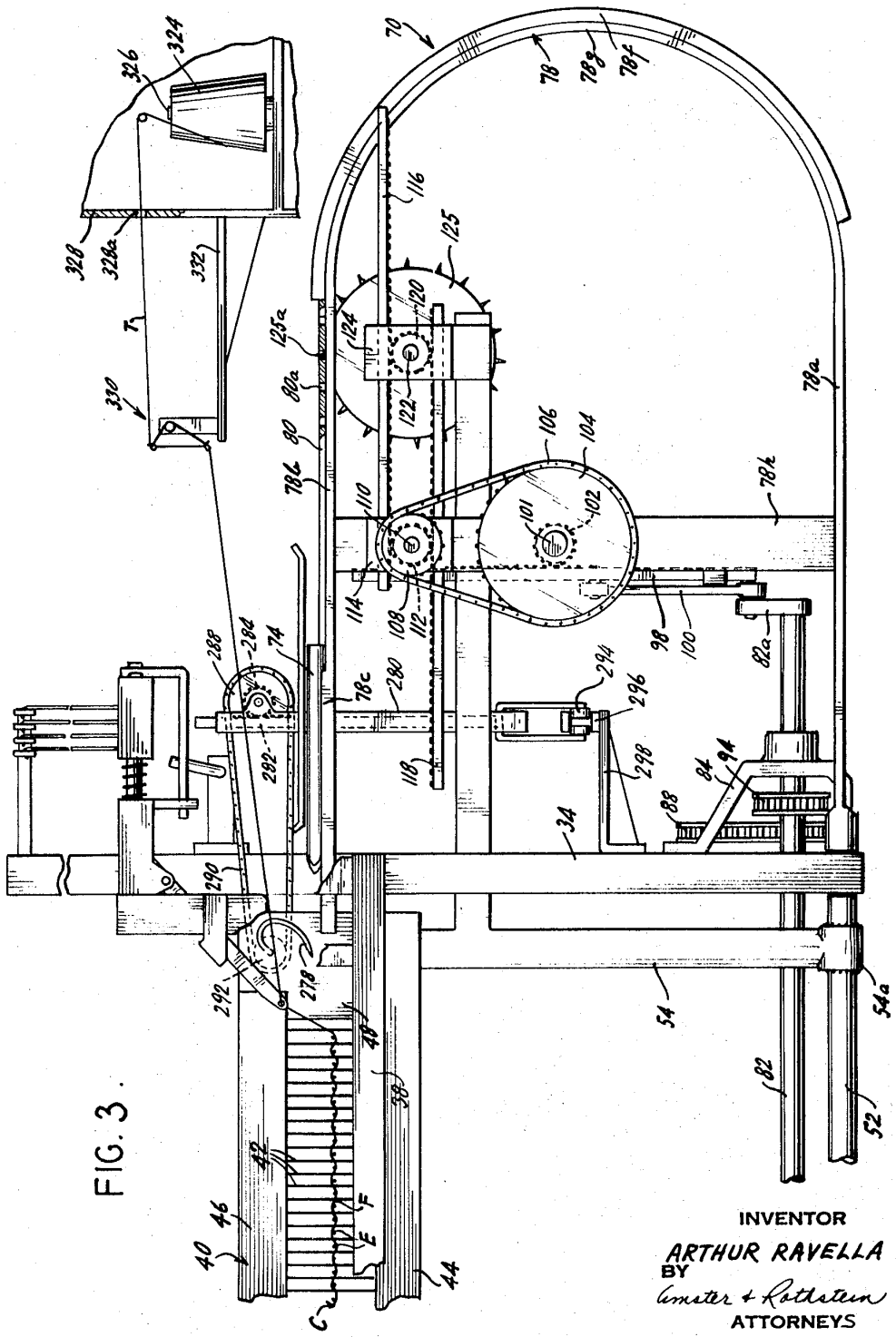

FIG. 3.

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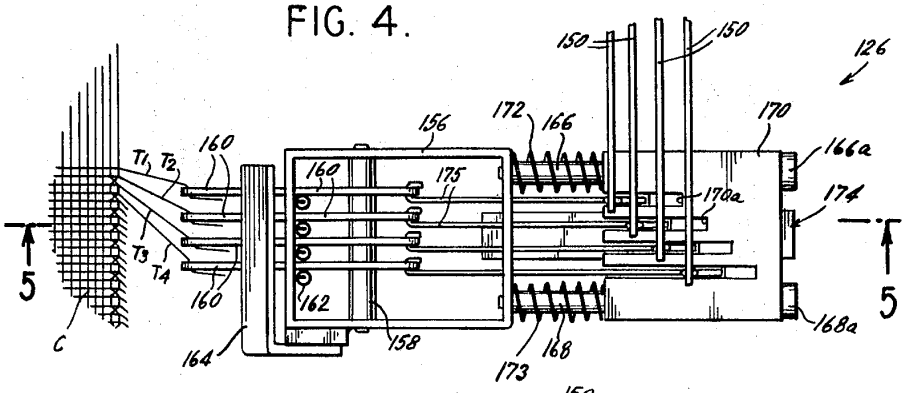
FIG. 4.



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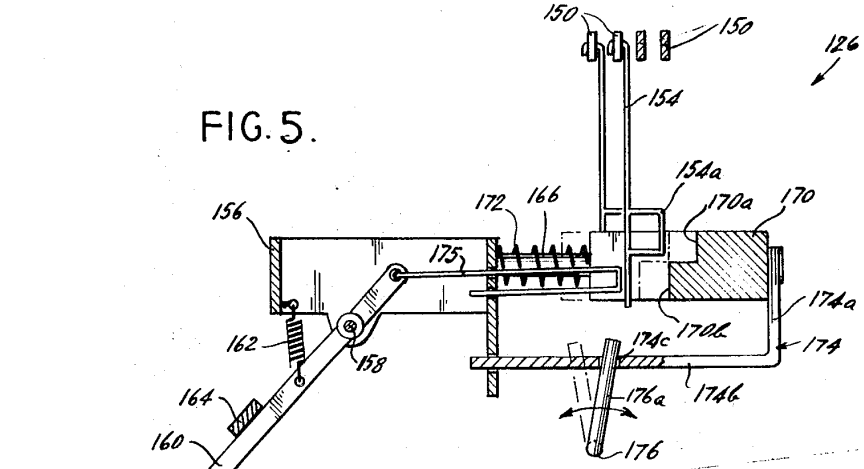

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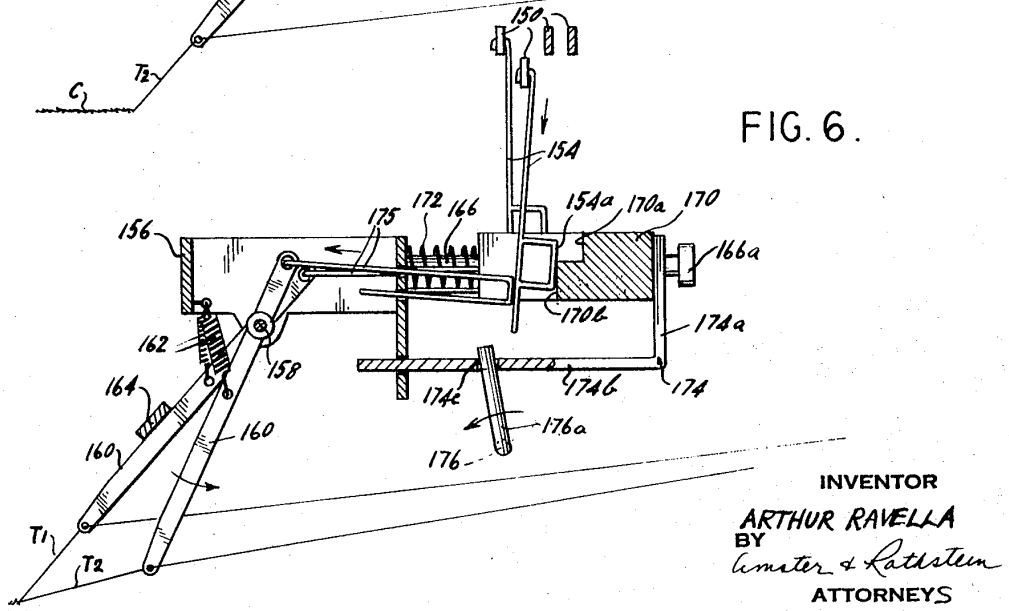

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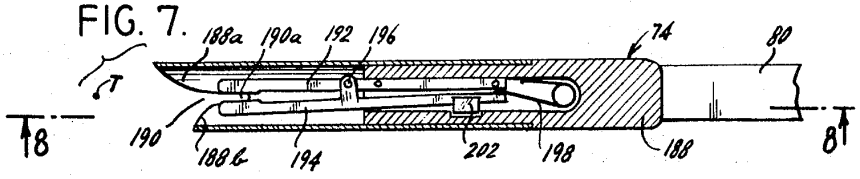
FIG. 7.



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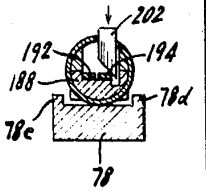


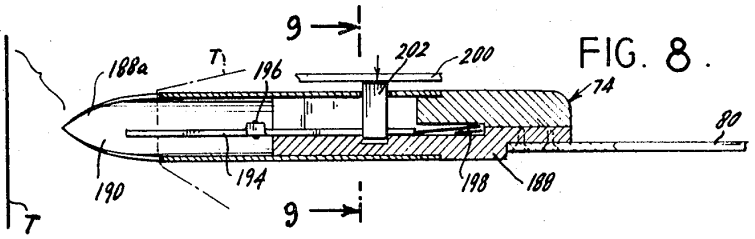
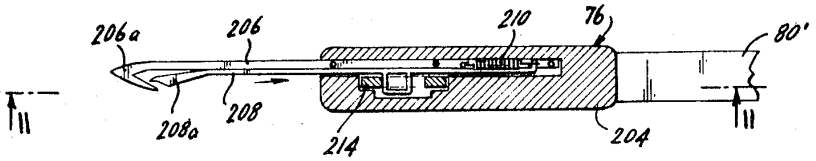


FIG. 8.

FIG. 10.



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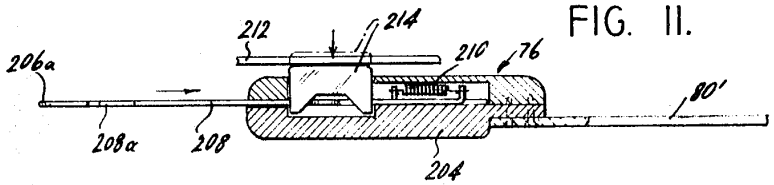

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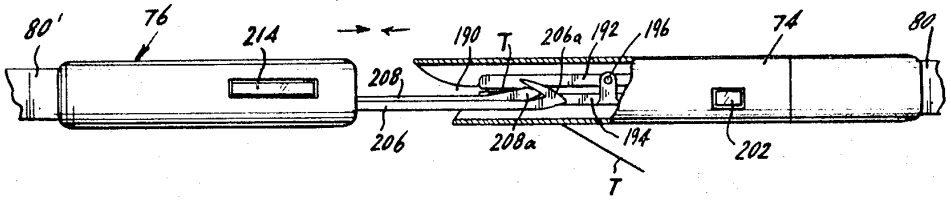

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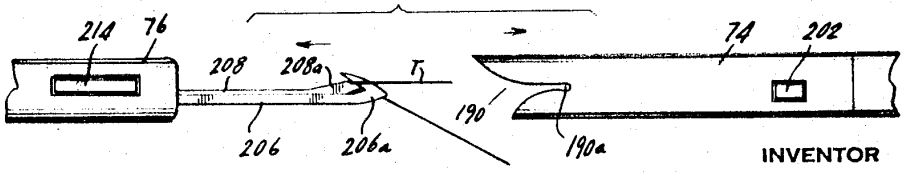

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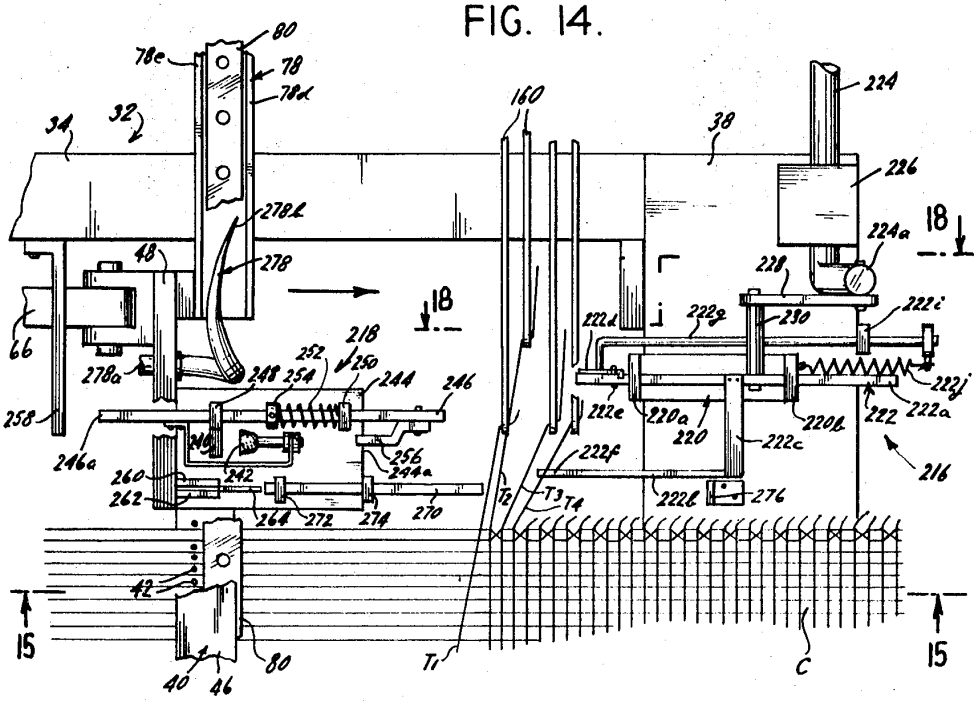
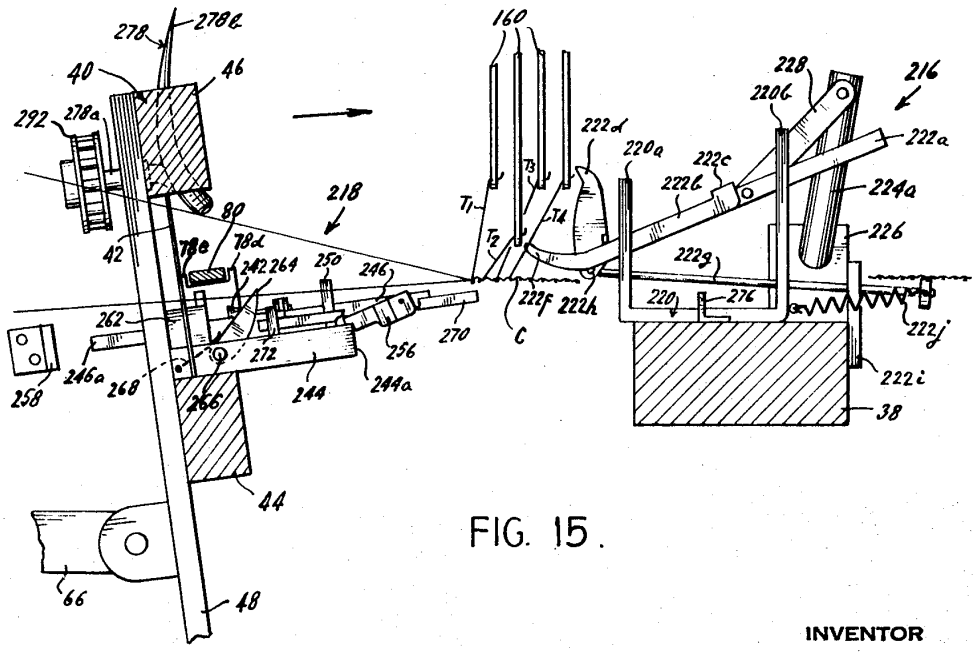
FIG. 14.





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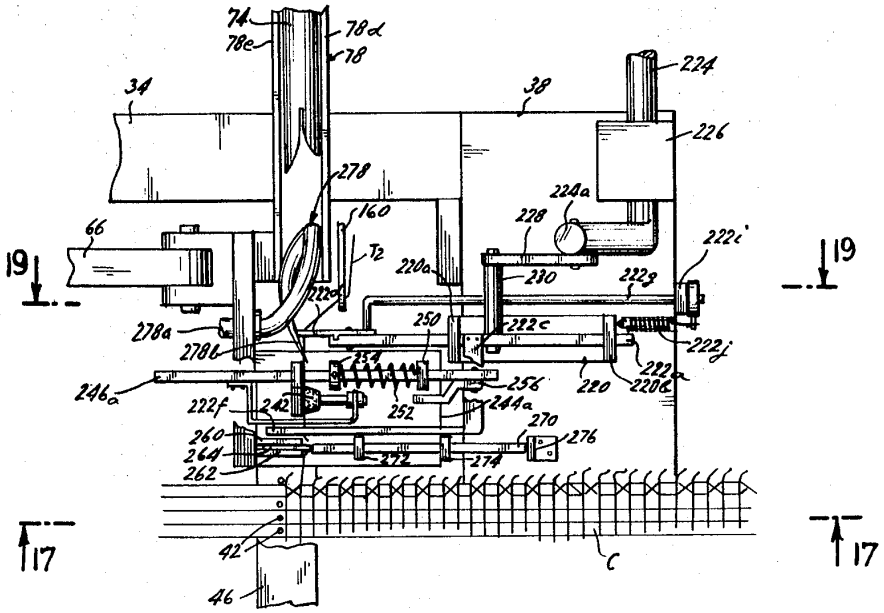

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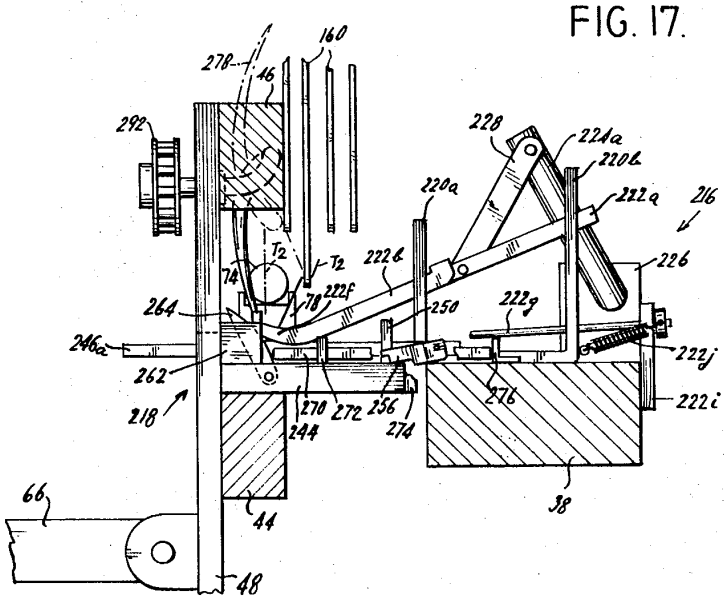

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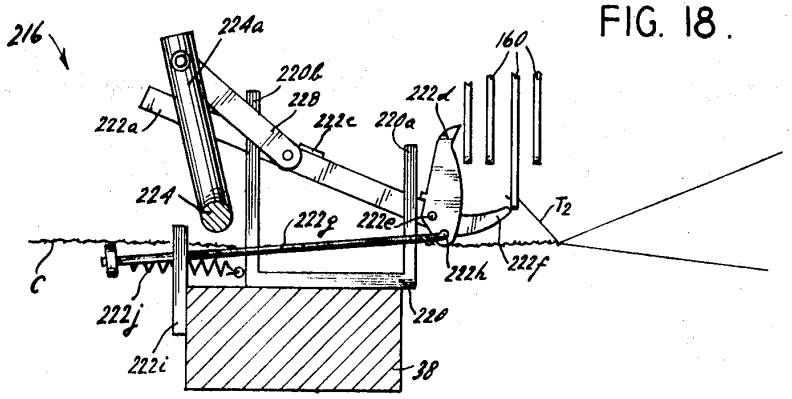
FIG. 18.



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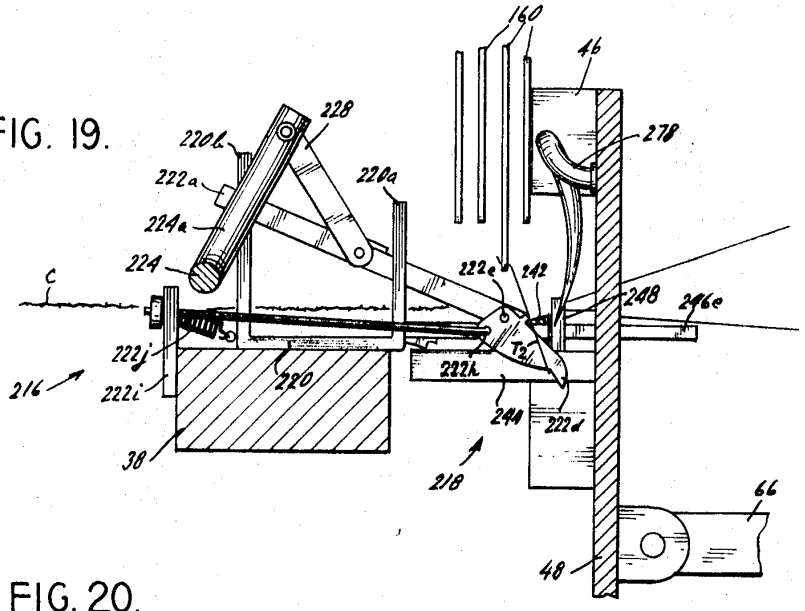

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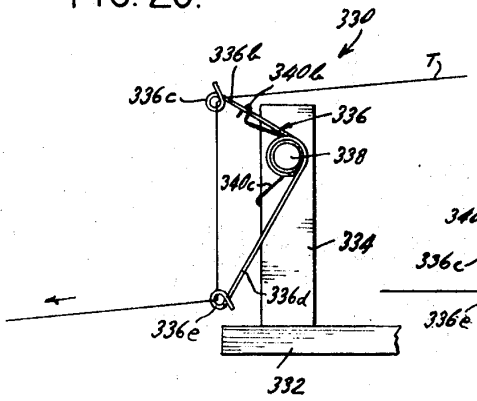

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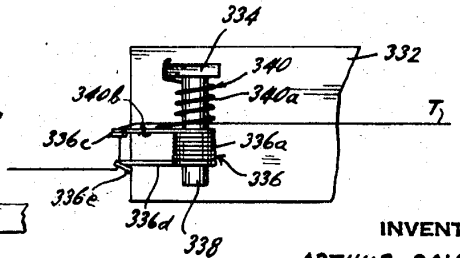

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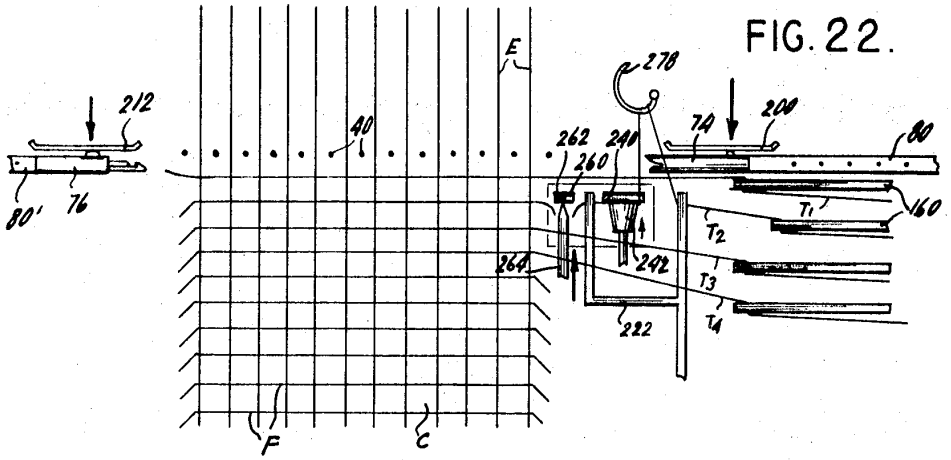

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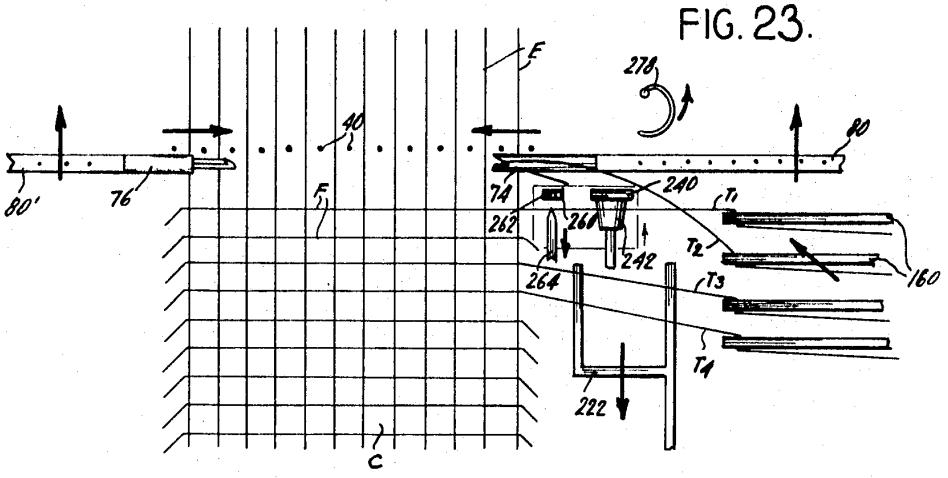

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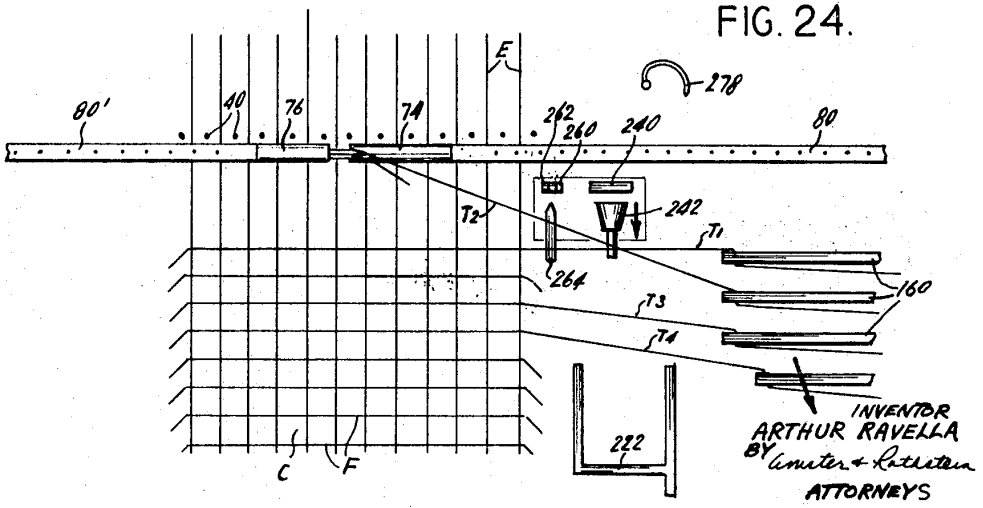

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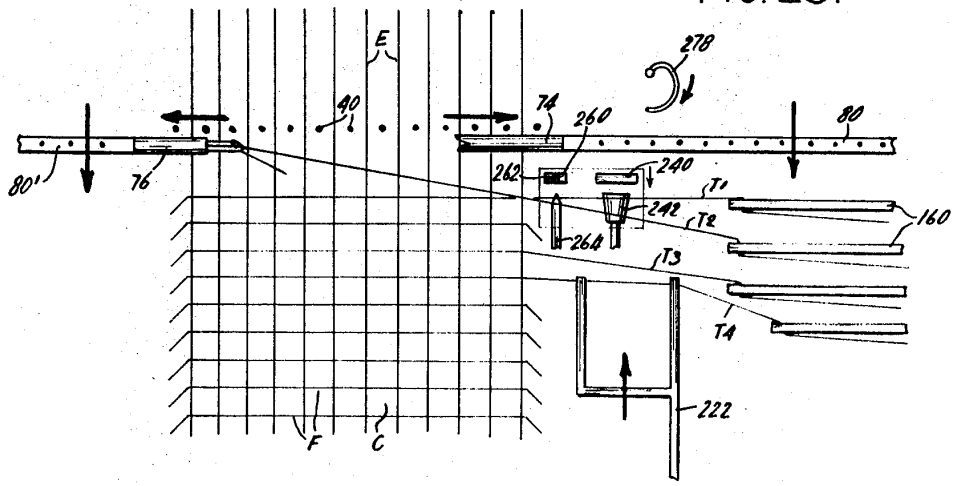
FIG. 25.



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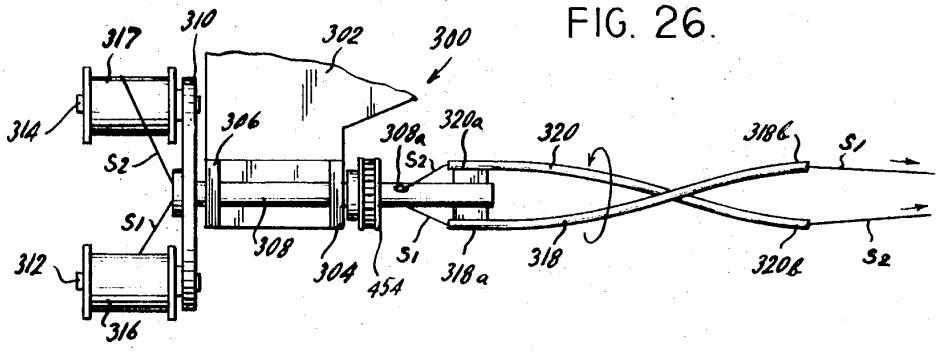

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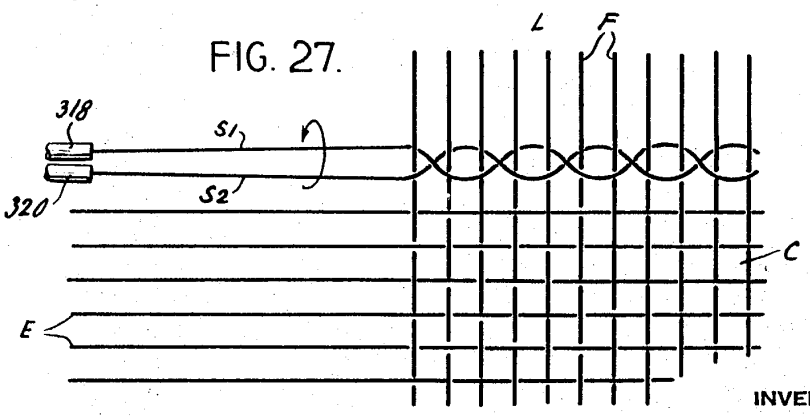

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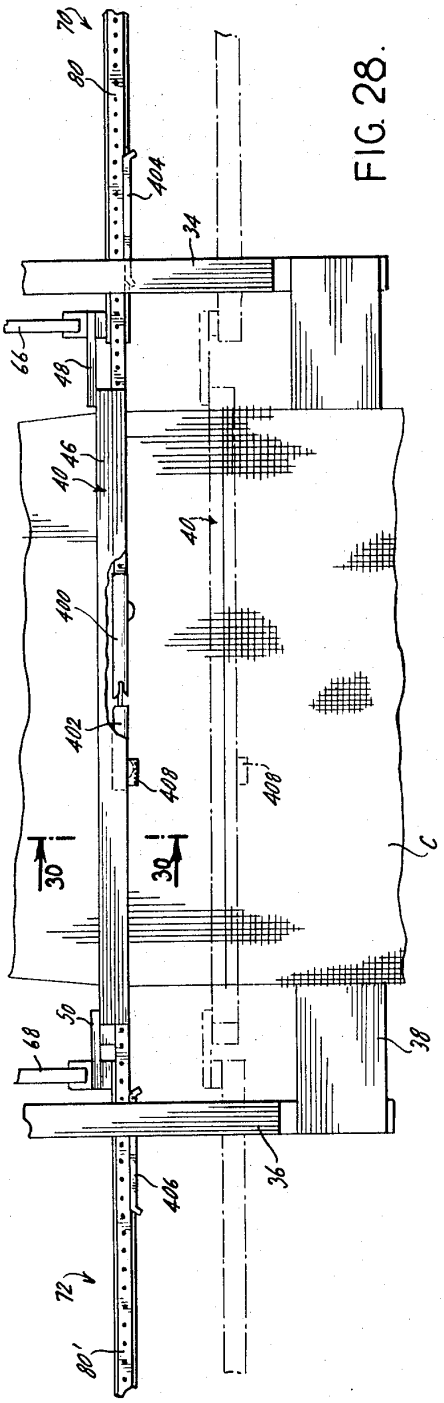

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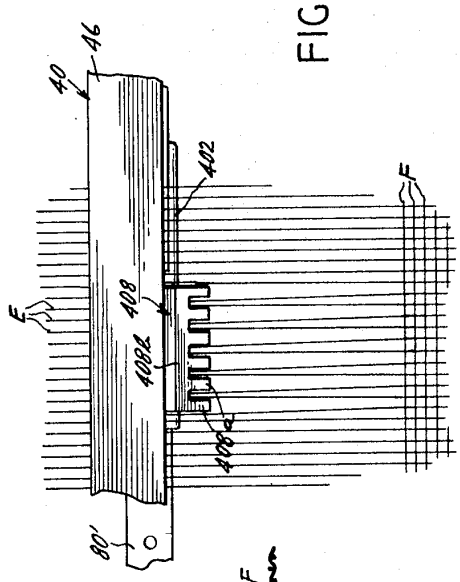

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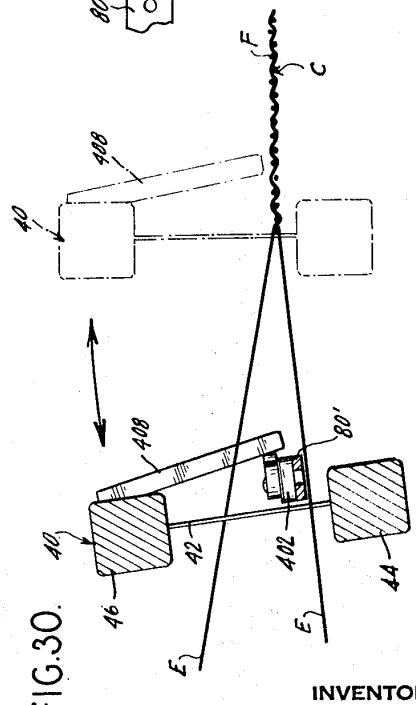

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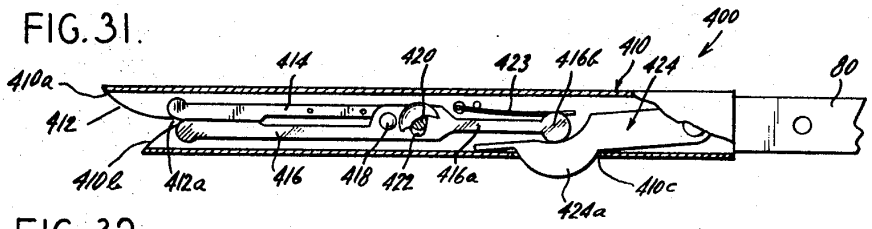
FIG. 31.



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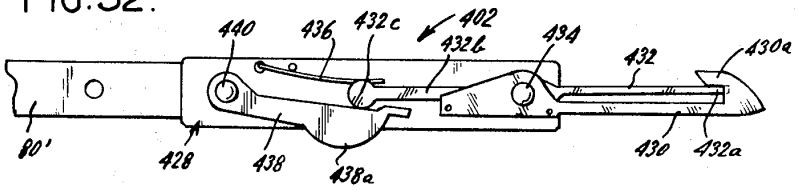

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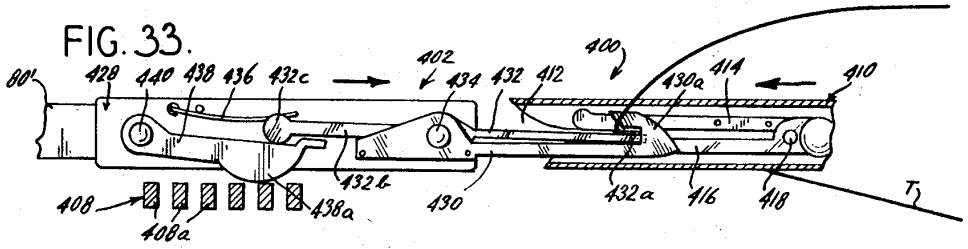

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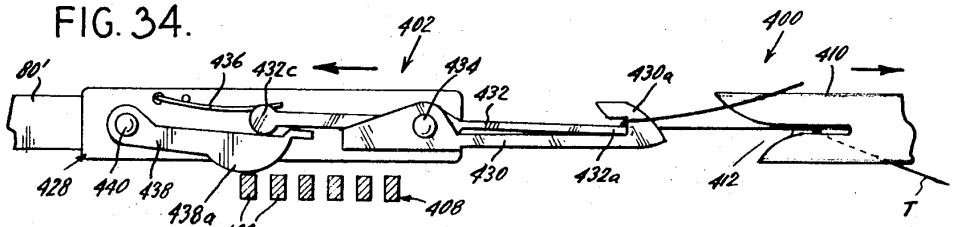


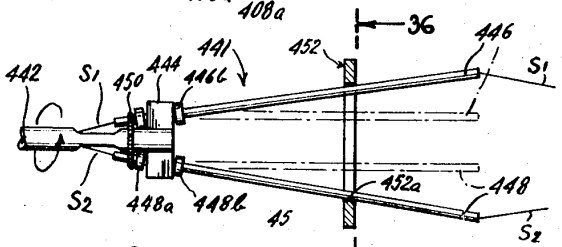
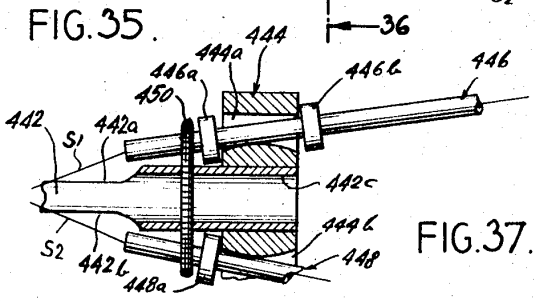


FIG. 35.



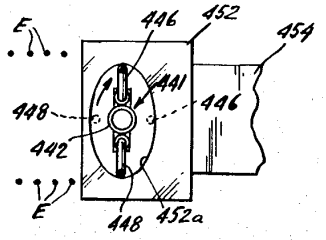


FIG. 36.

FIG. 37.

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SHUTTLELESS LOOM

The present invention relates generally to weaving looms, and in particular to an improved shuttleless cloth-weaving loom.

In a conventional weaving loom, individual shuttles are disposed in a shuttle-positioning mechanism which is periodically moved to bring a particular shuttle into a position to deliver its filling to the weft of the fabric. The pattern of the fabric is determined by the substance, color and picks of the weft or filling thread. Such shuttle looms are of complicated structure and involve the movement of relatively large masses, and thus are costly to manufacture and maintain. Often, they are more costly to operate since they are not particularly suitable for high-speed and continuous operation.

Through the years, a number of different shuttleless looms have been proposed in which filling thread carriers are moved through the shed or weaving section of the loom from the opposite sides of the weaving section, with one of the carriers picking up a selected weft or filling thread and carrying it from its side of the weaving section to the center of the shed and with the other of the thread carriers being arranged to pick up the weft thread at the center of the shed and complete the filling. Thereupon, the loom, operating in a conventional fashion, beats the filling into the shed of the cloth. In looms of this type, the weft of filling threads are wound on a number of relatively fixed bobbins or spools which are disposed at one side of the loom, with provision, as under the control of a perforated card, for selectively presenting a selected one of the several filling threads for pickup by the first carrier for movement to the medial pick-transfer location. The handling of the weft of filling thread for completing successive picks involves the initial positioning of the thread for selection as the filling, the pickup of the thread by the first carrier and the transfer of the picked up thread from the first carrier to the second carrier. Each of these manipulative operations must be performed every time a filling is placed into the cloth and literally thousands of such fillings are required in the weaving of a length of cloth. The equipment problem is further complicated by the fact that the mechanisms must be capable of handling filling threads of different diameters and of differing materials, from very coarse threads of natural fibers to finer threads of synthetic fibers, often in the very same fabric. Numerous suggestions have been made in the prior art for the construction of a loom of this type. Representative prior art patents are U.S. Pat. No. 2,151,085 of Mar. 21, 1939, U.S. Pat. No. 2,187,344 of Jan. 16, 1940 and U.S. Pat. No. 3,092,150 of June 4, 1963, all of which deal with the same general type of loom and the many problems presented in their construction for successful operation.

Broadly, it is an object of the present invention to provide an improved shuttleless weaving loom. Specifically, it is within the contemplation of the present invention to provide a shuttleless weaving loom which is capable of reliable operation over a prolonged period of time and is suitable for weaving a wide variety of fabrics including fillings of different size, texture and other physical characteristics.

More particularly, it is within the contemplation of the present invention to provide a shuttleless loom construction which may either be built as a new loom or may be employed to convert existing looms which have become outmoded and outdated such that the investment in such obsolete looms may be in part recaptured. Advantageously, in accordance with the present invention, it is possible to convert a number of different types of existing looms including a four-by-four box loom (Knowles) for operation on a shuttleless basis with a high order of reliability and loom efficiency.

In accordance with an illustrative embodiment demonstrating objects and features of the present invention, there is provided a shuttleless cloth-weaving loom which includes a frame having a weaving section and a shed-forming means in the weaving section having plural warped threads defining a fell which is adapted to have successive filling thread beat therein to complete the fell of the cloth. My improved loom includes a combined lay and carrier assembly which is movable through a beating stroke and is operable to selectively present picked filling threads in the shed for beating into the fell. This assembly includes first and second carriers which are movable from respective first and second clearance positions at the opposite side of the weaving section to a medial pick-transfer location relative to the weaving section. The first and second carriers each include cooperating thread-gripping jaws and means normally biasing the jaws into a closed position relative to each other. First jaw-actuating means are operatively arranged relative to the first carrier when in the first clearance position at one side of the weaving section for opening its thread-gripping jaws to receive a picked filling thread for advance to the pick-transfer location. Filling-selector and presenting mechanisms are provided at the one side of the loom for presenting a pick thread to the open and advancing thread-gripping jaws of the first carrier. The open thread-gripping jaws of the first carrier close in response to movement of the first carrier from the clearance position at the one side of the loom toward the pick-transfer location. The thread-gripping jaws of the first and second carriers are constructed and arranged to coact with each other in the pick-transfer location to transfer the pick-filling thread from the first carrier to the second carrier. The thread-gripping jaws of the second carrier are effective to complete the lay of the pick-filling thread into the shed as the second carrier moves from the pick-transfer location to the second clearance position. Second jaw-actuating means are operatively arranged relatively to the second carrier when in the second clearance position at the other side of the weaving section for opening its thread-gripping jaws to release the picked filling thread for beating into the fell. Coordinated drive means are provided for moving the combined lay and carrier assembly through the beating stroke and for moving the first and second carriers relative to each other in timed relation such as to progressively weave the cloth. Advantageously, the thread-gripping jaws of the first and second carriers are constructed and operated in a manner to assure positive pickup and transfer of the filling thread. Preferably means are provided at the pick-transfer location for opening the closed jaws of the second carrier as the carriers approach the medial pick-transfer location such that the open jaws of the second carrier will receive the picked filling thread from the first carrier.

The above brief description, as well as further objects and features of the present invention will be more fully appreciated by reference to the following detailed description of a presently preferred loom and several alternative constructions in the loom, when taken in conjunction with the accompanying drawing, wherein:

FIG. 1 is a plan view of a loom embodying features of the present invention, with the assembly of the lay and pick carriers being shown in operative or beating position and with the inoperative or retracted position thereof being illustrated by the dot-dash lines;

FIG. 2 is a side elevational view of the loom taken from the right of FIG. 1;

FIG. 3 is a fragmentary front elevational view of the loom showing the details of the right section and first pick carrier assembly, there being a substantially identical but mirror image left section and pick carrier assembly on the other side of the loom;

FIG. 4 is an enlarged fragmentary plan view showing details of the filling-selector mechanism in its inoperative position;

FIG. 5 is a sectional view taken substantially along the lines 5—5 of FIG. 4 and looking in the direction of the arrow showing details of the filling-selector mechanism, with the parts thereof in the inoperative position;

FIG. 6 is a vertical sectional view similar to FIG. 5 but showing the filling-selector mechanism actuated for presenting a particular filling thread for a pick by the loom mechanisms;

FIG. 7 is a horizontal section through the first carrier of the loom which picks up a selected filling thread and advances the same to a medial pick-transfer location;

FIG. 8 is a sectional view taken substantially along the line 8—8 of FIG. 7 and looking in the direction of the arrows showing details of the first carrier with a selected thread being illustrated as being gripped by the closed first carrier jaws;

FIG. 9 is a transverse sectional view taken substantially along the line 9—9 of FIG. 8 and looking in the direction of the arrows showing the camming mechanism for opening the first carrier jaws to receive a selected filling thread;

FIG. 10 is a transverse sectional view through the second carrier of the loom which picks up a picked thread at a medial pick-transfer location and which serves to complete the lay of the picked filling;

FIG. 11 is a vertical sectional view taken substantially along the line 11—11 of FIG. 10 and looking in the direction of the arrows showing further details of the second carrier;

FIG. 12 is a fragmentary plan view, with parts broken away and in section, showing the coaction between the first and second carriers of the filling arrangements shown at the medial pick-transfer location during transfer of a picked thread from the first or right carrier to the second or left carrier;

FIG. 13 is a view similar to FIG. 12 after transfer of a picked thread from the first or right carrier to the second or left carrier and showing the carriers as they are moving away from each other from the medial pick-transfer location;

FIG. 14 is a fragmentary plan view taken along the right side of the loom and showing the mechanisms for presenting a picked thread for temporary holding, cutoff and presentation to the first carrier of the pick-filling mechanism, with the loom in the open position wherein the assembly of the lay and first and second carriers are retracted from the fell formed by the ends or warp of the cloth;

FIG. 15 is a sectional view taken substantially along the lines 15—15 of FIG. 14 and showing the relative position of the mechanisms in the open position of the loom;

FIG. 16 is a fragmentary plan view of a portion of the loom shown in FIG. 14 but in the closed position wherein the assembly of the lay and first and second carriers have moved substantially through the beating stroke and showing the mechanisms for presenting a thread for engagement by the advancing first carrier of the filling mechanism;

FIG. 17 is a vertical section taken substantially along the line 17—17 of FIG. 16 and looking in the direction of the arrows;

FIG. 18 is a sectional view taken substantially along the line 18—18 of FIG. 14 showing the side of the thread transfer mechanism opposite from that illustrated in FIG. 15;

FIG. 19 is a view similar to FIG. 18, but showing the mechanisms at the completion of the beating stroke wherein the reed is in the fell of the cloth contiguous to the breastbeam of the loom;

FIG. 20 is a fragmentary elevational view of a typical thread-tensioning system employed in the present loom;

FIG. 21 is a plan view of the thread-tensioning system shown in FIG. 20;

FIGS. 22–25 inclusive are progressive diagrammatic and schematic showings in plan of the basic mechanisms of the loom progressively illustrating a typical operating cycle;

FIG. 26 is a fragmentary plan view of a typical selvage-binding mechanism incorporated in the present loom;

FIG. 27 is a fragmentary plan view showing the manner in which the selvage-binding mechanism of FIG. 26 binds the salvage of the woven cloth;

FIG. 28 is a fragmentary plan view of a loom having a modified carrier and carrier-actuating arrangement in accordance with further features of the present invention;

FIG. 29 is a fragmentary elevational view at the medial pick-transfer location of the modified loom illustrated in FIG. 28;

FIG. 30 is a fragmentary sectional view taken substantially along the line 30—30 of FIG. 28 showing details of the lay of the loom having the carrier-actuating cam thereon, with the full lines showing the lay in the retracted position and the dotted lines showing the lay in the beating position in the fell of the cloth;

FIG. 31 is a plan view, with parts broken away and in section, of a modified first carrier embodying further features of the invention which carrier is useful in the modified loom illustrated in FIGS. 28–30;

FIG. 32 is a plan view of a modified second carrier for use in the loom illustrated in FIGS. 28–30;

FIG. 33 is a plan view, with parts sectioned, showing the coaction of the first and second carriers at the medial pick-transfer location wherein the pick which has been laid halfway across the cloth and is being transferred from the first carrier to the second carrier;

FIG. 34 is a view similar to FIG. 33 but showing the first and second carriers moving away from the medial pick-transfer location, the pick having been transferred to the second carrier;

FIG. 35 is a plan view of a modified selvage-binding mechanism embodying further features of the present invention;

FIG. 36 is a plan view taken substantially along the line 36—36 in FIG. 35 and looking in the direction of the arrows; and

FIG. 37 is a fragmentary plan view, on an enlarged scale, and with parts broken away, showing the mounting arrangement for the thread-twisting tubes incorporated in the modified selvage-binding mechanism illustrated in FIGS. 35 and 36.

Referring now specifically to the drawings, and in particular to FIGS. 1–3, there is shown a typical loom 30 embodying features of the present invention which includes a main frame 32 having opposite side frame members 34, 36 interconnected at their forward end by a breastbeam 38 over which the finished cloth C passed, as indicated by the directional arrow, towards a conventional takeup. As is generally understood, the filling or weft F of the cloth C is composed of successive picks of thread which are beat into the fell formed by the ends of warp E of the cloth. To this end, the loom 30 includes a lay 40 which extends transversely of the loom intermediate the side frame members 34, 36 and is movable between the open position shown by the dotted lines in FIG. 1 and the operative or beating position shown by the full lines in FIG. 1.

As seen best in FIGS. 3 and 14–17 inclusive, the lay 40 includes a plurality of parallel and vertical reeds 42 which extend between a reed support 44 and a reed cap 46. The reeds 42 extend through to the cloth or goods C and serve to beat successive picks of the filling F into the fell of the cloth. At locations outwardly of the margins or selvages of the goods C, the reed support 44 and reed cap 46 are interconnected by end plates 48, 50 (see FIG. 1).

The lay 40 is mounted for rocking movement from the open position (see the dotted lines shown in FIG. 1 and FIGS. 14 and 15) through the beating stroke (see the directional arrow in FIG. 15) into the closed or operative position (see the full line shown in FIG. 1 and FIGS. 16 and 17) on a lay rocker shaft 52, (see FIG. 3) which extends transversely of the machine and is journaled by appropriate bearings on the opposite side frame members 34, 36 of main frame 32. The lay 40 is mounted on the rocker shaft 52 by depending mounting arms 54 welded or otherwise secured to the end plates 48, 50 and terminating in hubs 54*a* which are attached to the lay rocker shaft 52 (see FIG. 3).

Rocking motion is imparted to the lay 40 from the main drive motor 56 of the machine, seen in FIG. 1. Specifically, the main drive motor 56 includes the usual speed reduction and control gearing and has its output shaft 56*a* connected to a main shaft 58 which extends from side to side of the machine and is journaled in the side frame members 34, 36. Outwardly of the side frame member 36, the main shaft 58 carries a main drive gear 60 which engages a crankshaft drive gear 62 carried on a crankshaft 64 which is likewise journaled on the side frame members 34, 36 at a location somewhat forwardly of and above the main shaft 58 (see FIGS. 1 and 2). The crankshaft 64 includes crank arms 64*a*, 64*b* which are connected by respective connecting links 66, 68 to the end plates 48, 50 of the lay 40. Thus, the rotary motion of the crankshaft 64 will be translated into the requisite rocking motion of the

lay **40** for moving the latter through the requisite beating stroke.

Projecting outwardly from the opposite sides of the machine **30** are first and second carrier assemblies, generally designated by the reference numerals **70, 72**. The carrier assemblies **70, 72** are of substantially identical construction, except for the details of the first and second carriers **74, 76** and their respective functions. Accordingly, it will suffice to generally describe these structures by referring to the carrier assembly **70** in conjunction with FIGS. **7** to **12** inclusive and to separately describe the details of the first and second carriers **74, 76**. The carrier assembly **70**, seen best in FIGS. **1** to **3** inclusive, includes an upstanding subframe **78** of U-shape which is mounted and extends horizontally to rock back and forth with the lay **40**. Specifically, the lower leg **78***a* of the subframe **78** is connected to the lay rocker shaft **52** while the upper leg **78***b* is connected to the lay **40**. The terminal section **78***c* of the upper leg **78***b* of rockable subframe **78** is provided with lateral guides **78***d*, **78***e* (see FIG. **15**) to appropriately confine the first carrier **74** in its retracted position to one side of the lay **40** and prior to its passage from the one side of the loom toward a medial pick-transfer location wherein the first carrier **74** coacts with the second carrier **76** to transfer a thread pick. The first carrier **74** is mounted on a flexible rapier strap **80** which is guided by the U-shaped subframe **78** serving as a track. As illustrated, a major portion of the flexible rapier strap **80** is received within an elongated curved guideway formed by the tunnel-forming member **78***f* and the contiguous right portion **78***g* of the subframe **78**.

Provision is made for imparting drive to the flexible rapier strap **80** to propel the first carrier **74** from its retracted starting position outwardly of the side frame member **34** to first pick up a filling thread T and to then carry the picked filling thread to the medial pick-transfer location and finally to return the first carrier to its starting position for pickup of the next filling thread. In similar fashion, provision is made for reciprocating the second carrier **76** via its flexible rapier **80**[1] to bring the second carrier to the medial pick-transfer location wherein it picks up the filling thread and completes the operation of placing the picked filling thread. Thereupon, the picked thread is beat into the fell of the cloth C by the vertical reeds **42** of the lay **40**, as is generally understood. The construction of the identical and symmetrically disposed rapier drives at the opposite sides of the machine will be best understood by reference to FIGS. **1** to **3** which shows the rapier drive associated with the first carrier assembly **70**. Specifically, a rapier-actuating shaft **82** is journaled transversely of the machine at a location forwardly of and somewhat below the main shaft **58** (see FIGS. **2** and **3**). The opposite ends of the rapier-actuating shaft **82** are journaled on the side frame members **34, 36** as by the provision of an appropriate bracket and bearing **84** mounted on the outer face of the adjacent side frame member **34** (see FIGS. **2** and **3**). Drive is imparted to the rapier-actuating shaft **82** by a main shaft sprocket **86** connected to the main shaft **58** and coupled via chain **88** to an intermediate double-decked sprocket **90**. Sprocket **90** is mounted on stub shaft **92** which in turn is connected via chain **94** to the driven sprocket **96** on the rapier-actuating shaft **82**. The rapier-actuating shaft **82** carries a crank arm **82***a* which extends parallel to an intermediate supporting post **78***h* of the subframe **78**. The supporting post **78***h* has slidably mounted thereon a vertically extending rack **98** which is driven from the crank **82***a* by an appropriate connecting rod **100** which is pivotally connected at its extremities to the crank arm **82***a* and to the rack **98**. Journaled on the post **78***h* is a pinion shaft **101** which carries at its rearward side pinion **102** which is engaged by rack **98**. At its forward side, the pinion shaft **101** carries a driving sprocket **104** which is coupled via chain **106** to a driven sprocket **108** which in turn is journaled on post **78***h* via pinion shaft **110**. Pinion shaft **110** carries a pinion **112** which is journaled within a housing **114** mounted on the post **78***h*. The pinion **112** engages and reciprocates upper and lower racks **116, 118** which actuate the rapier **80**. Specifically, the racks **116, 118** impart rocking motion to the output pinion **120** which is journaled on pinion shaft **122** mounted via bracket **124** on the outer extremity of a lateral support **54***a* which is integral with and projects outwardly of the lay-supporting arm **54**. Mounted on the output pinion shaft **122** is a rapier-driving sprocket **125** which has radial driving pins **125***a* extending through corresponding holes **80***a* in the flexible rapier strap **80** for imparting reciprocal motion thereto. The driving pinion **125** is effective to drive the flexible rapier strap **80** through the requisite pick-transfer stroke to displace the first carrier **74** from the retracted starting position at the side of the machine, removed from the lay **40**, to the medial thread-transfer position centrally of the lay **40**.

Reference will now be made to the filling-selector mechanism **126** which is disposed at the right side of the machine **30** and in position for coaction with the first carrier **74** to present a particular thread or pick T to the carrier **74** to be pulled approximately halfway across the lay **40** for medial transfer to the second carrier **76** which then completes the corresponding pick. The illustrative filling-selector mechanism **126** has been shown with the capability of selecting any one of four threads, specifically designated at T_1, T_2, T_3 and T_4. It will be appreciated that a greater or lesser number of threads T may be provided for the selection of picks of different colors, materials, thickness, etc. to provide a great variety of cloth patterns, as is generally understood by those working with looms of this general type. As seen best in FIGS. **1** and **2**, the filling-selector mechanism **126** includes a filling indicator tape **128** which has four side-by-side longitudinal tracks of appropriate punchings which are read transversely, row by row, to select successive picks for the filling in accordance with the hole pattern in the tape **128**. The tape **128** passes about a drum **130** (having appropriate lateral flanges thereon), guide roller **132** and a floating biasing roller **134** and then over a readout platen **136**. The tape **128** is indexed stepwise past a transverse readout location on platen **136** by an indexing rachet **138** on the drum **130**. The indexing rachet **138** is driven by a vertically reciprocal pawl **140** slidably mounted on the adjacent side frame member **34** of the machine. The pawl **140** carries a depending cam follower **142** which engages the tape-indexing cam **144** mounted on the end of the crank shaft **64** outwardly of side frame member **34**.

Overlying the filling indicator tape **128** (which, as described is indexed stepwise for signalling successive picks) are four parallel readout levers **146**. The levers extend fore and aft of the machine and are each pivoted intermediate their ends on shaft **148** fixed to the adjacent side frame member **34**. The rearwardly projecting arms **146***a* of the readout levers **146** carry depending pins or fingers **146***b* which ride along the appropriate tracks of the filling indicator tape **128**. In response to the selection of a particular thread, the corresponding readout pin **146***b* fall such that the forwardly projecting arm **146***c* of the selected readout levers is raised. In the illustrative showing, the readout lever **146** for the thread T_2 has been selected for the next pick to illustrate a typical operating condition. After each readout, pawl **140** operates lift member **149** to clear the depending pins **146***b* from the filling indicator tape **128** to permit tape index in response to the upward stroke of the pawl **140**.

The forward ends of the readout levers **146** are each connected to a corresponding intermediate connecting lever **150**, with the four connecting levers **150** being mounted on pivot **152** on side frame member **34**. Specifically, each of the forwardly projecting arms **146***c* of the readout levers **146** are received within somewhat oversized bearing holes in corresponding rearwardly projecting arms **150***a* of the intermediate connecting levers **150**. The forwardly projecting arms **150** of the intermediate connecting levers **150** carry respective depending selective coupling members **154**, seen best in FIGS. **1** and **4–6** inclusive. As may be appreciated by progressively considering FIGS. **5** and **6**, the lowering of any one of the selective coupling members **154** (such as the one corresponding to thread T_2)will bring about a selection of that

thread for the next pick, as will be fully understood by considering the following description. Specifically, a rectangular open finger frame **156** (see FIG. 4) is mounted on the main frame **32** of the machine by appropriate bracketing. Frame **156** carries a pivot shaft **158** extending fore and aft of the machine on which there is pivoted four thread-selection fingers **160**. The fingers **160** project downwardly and forwardly toward the cloth or goods C (as seen in FIGS. **5** and **6**), with the selected finger (i.e., finger for thread T_2) moving in the counterclockwise direction as indicated in FIG. **6** under the control of filling indicator tape **128**. The several thread-selection finger **160** are urged against the position stop **164** by individual springs **162** connected between the fingers and the finger frame **156**.

Projecting from the side of the finger frame **156** remote from the thread-selection fingers **160** are a pair of spaced and parallel guide rods **166**, **168** on which there is slidably mounted an actuator block **170**. The actuator block **170** is normally biased to the retracted position illustrated in FIGS. **4** and **5** against the enlarged heads **166***a*, **168***a* of the guide rods **166**, **168** by coil springs **172**, **173**. As seen in FIG. **5**, the coupling members **154** are each formed with an enlarged coupling head **154***a* which is selectively disposed at a level either opposite the surface **170***a* or the surface **170***b*. When a coupling member **154** is in its normal or unactuated position, its coupling head **154***a* is unaffected by the actuator block **170** in that there is sufficient clearance between the surface **170***a* and the coupling head **154***a* such that the forward thrust of the actuator block **170** (compare FIGS. **5** and **6**) imparts no motion to the coupling member **154**. However, when a particular coupling member **154** is lowered such that the coupling head **154***a* thereof is opposite the surface **170***b* of the actuator head **170**, forward thrust of the actuator block **170** will be effective to impart motion to the corresponding selected thread-selection finger **160** via the motion transfer member **175**. As seen in FIGS. **4** to **6** inclusive, the motion transfer members **175** for the thread-selection fingers **160** are pivotally connected to such fingers and slidably mounted on the finger frame **156** to be displaced in response to movement of the actuator block through its operative stroke.

Provision is made for driving the actuator block **170** through its operative stroke toward the finger frame **156** by an L-shaped drive plate **174** which has its short leg **174***a* fixed to the actuator block **170** and its long leg **174***b* guided in the finger frame **156**. As seen best in FIG. **2**, reciprocal motion is imparted to the drive plate **174** from a rocker shaft **176** which is journaled on the side frame member **34** by bearings **178**, **180**. The rocker shaft **176** has its offset arm **176***a* engaged within a cutout **174***c* formed in the long arm **174***b* of the drive plate **174** (see FIGS. **5** and **6**). The rocker shaft **176** is driven by crank arm **182** which is pivotally connected to a vertically reciprocal cam follower **184** slidably mounted on the side frame member **34** and engaging actuating cam **186** on crankshaft **64**. The development of cam **186** and the timing of its actuation is such that rocking motion is imparted to the rocker shaft **176** at the appropriate time in the operating cycle to present the thread (i.e., thread T_2) associated with a particular thread-selection finger **160** to the first carrier **74** as determined from the filling indicator tape **128** and the selection chain **146**, **152**, **154**, **172** and **160** of the filling-selector mechanism **126**. At the end of any particular selection, the actuator block **170** returns to its retracted position (see FIG. **5**). During the next thread selection interval, an appropriate one of the coupling members **154** is lowered to position its corresponding thread for selection as the filling for the cloth C.

Reference will now be made to FIGS. **7** to **9** inclusive for a description of the construction of the first carrier **74** which is mounted on the flexible rapier **80** of the first carrier assembly **70**. The first carrier **74** includes a carrier body **188** which is fixed to the rapier **80** and is formed at its forward end with a laterally flared open mouth **190** which gradually merges into a reduced thread-receiving throat **190***a*. The open mouth **190** and its throat **190***a* are defined and bounded by opposed lips **188***a*, **188***b* formed on the carrier body **188** and having confronting and outwardly flaring thread-guiding surfaces. Extending at one side of the reduced throat **190***a* is a stationary carrier jaw **192** which is fixed (as by rivets) to the carrier body **188**. Extending at the opposite side of the reduced throat **190***a* is a movable carrier jaw **194** which is pivoted at pin **196** for movement into and out of closing relation to the stationary carrier jaw **192**. The pivoted carrier jaw **194** is normally biased into a closed position against the stationary carrier jaw **192** by the internal bias spring **198**.

Provision is made to hold the movable jaw **194** in the open position illustrated in FIG. **7** both when the first carrier **74** is in its retracted starting position outwardly of the side frame member **34** of the loom **30** and when the first carrier moves through the location in which it picks up the thread for the selected filling. The selected thread is then advanced by the first carrier **74** into the medial pick-transferring location, shown by the dot-dash lines in FIG. **1**. Control of the first carrier **74** is accomplished by providing a fixed cam **200** which overlies the first carrier **74** in its retracted starting position (see FIGS. **1** and **3**). The fixed cam **200** engages a vertically movable cam follower **202** which is mounted transversely of the carrier body **188** in position to engage the movable jaw **194** and pivot the same to the open position illustrated in FIG. **7** against the bias of the spring **198**. As may be best appreciated from FIG. **3**, the lateral position and longitudinal extent of the cam **200** is such as to present open carrier jaws **192**, **194** at the opposite sides of the mouth and throat **190**, **190***a* for thread reception. When the first carrier is moved inwardly of the cam **200** to a position wherein the follower **202** is released, carrier jaws **192**, **194** close to grip the selected thread.

The second carrier **76** is seen in FIGS. **10** and **11** to include a carrier body **204** mounted on the flexible rapier strap **80'**. Projecting forwardly of the carrier body **204** are a fixed carrier jaw **206** and a movable carrier jaw **208**. The leading end of the fixed carrier jaw **206** terminates in a hook **206***a* while the leading end of the movable jaw **208** terminates in a jaw-closing finger **208***a* which is engageable within the hook **206***a*. Carrier jaw **208** is slidable longitudinally relative to carrier jaw **206** and is normally biased by spring **210** into a position where the finger **208***a* is engaged within the hook **206***a* to form a releasable spring-biased keeper for the thread. In this illustrative embodiment, the selected pick is forced into the keeper defined by the coacting elements **206***a*, **208***a* at the medial pick-transfer location, with provision being made at the end of the placement of the selected pick or filling to open the second carrier **76** as it returns to the retracted starting position outwardly of the side frame member **36**. To this end, a fixed cam **212** (see FIGS. **1** and **11**) is arranged to overlie the path transversed by the second carrier **76** as it is retracted to the retracted starting position outwardly of the side frame member **36**. The fixed cam **212** actuates a vertically movable cam follower **214** which is mounted on the carrier body **204** and engages the reciprocable jaw **208** of the second carrier **76**.

Referring now to FIGS. **12** and **13**, there is shown the manner in which the first and second thread carrier **74**, **76** cooperate with each other in achieving a pick transfer at the medial pick-transfer location. As you see in FIG. **12**, the carrier **74**, **76** approach each other, as indicated by the directional arrows. Prior to transfer, the thread T is held between the closed first carrier jaws **192**, **194** in the restricted throat **190***a* of its open mouth **190**. Continued movement of the carriers **74**, **76** into interengagement brings the spring-biased keeper **206***a*, **208***a* into the open mouth **190***a* of the first carrier **74** and behind the thread T. Thus, after the first and second carriers reach the inner limit of their respective strokes and begin to move away, as indicated by the directional arrows in FIG. **13**, the hook **206***a* engages the thread T and presents the same to the spring-biased keeper such that in response to continued return movement of the second carriers **76**, the pick is stripped from between the closed carrier jaws **192**, **194** of the first carrier **74** and gripped by the spring-biased jaws **206**, **208**

of the second carrier **76**. In this illustrative embodiment, pick-transfer is achieved by utilizing closed pairs of spring-biased carrier jaws, with the tension being exerted on the selected thread or pick T being sufficient to achieve release from the first carrier **74**, transfer to the second carrier **76** and retention by the second carrier **76** until final release at the completion of the pick. However, when working with heavier threads, it is preferable to employ a different pick-transfer technique, as will be subsequently described.

Reference will now be made to FIGS. **14** through **19** for a description of the mechanisms by which the selected thread or pick (i.e., thread T_2) is presented for pickup by the first carrier **74** as the lay **40** and carrier assembly **70**, **72** move toward the breastbeam **38** of loom to beat the previous pick into the fell. More specifically, these coacting devices include a thread-orienting mechanism **216** on the breastbeam **38** which positions a selected thread substantially horizontally for engagement by transfer mechanism **218** on the lay and carrier assemblies **40**, **70** and **72** wherein the appropriately presented thread is picked up, oriented in a substantially vertical attitude for engagement by the first carrier **74** and then cut off such that the selected pick may be laid into the fell by cooperating carriers **74**, **76** for beating in response to the next operative stroke of the lay **40**.

Considering first the thread-orienting mechanisms **216** on the breastbeam **38**, an upstanding U-shaped carrier support **220** is fixed to the breastbeam transversely thereof and contiguous to the thread-selection fingers **160**. The carrier support **220** includes upstanding forward and rearward arms **220***a*, **220***b* which serve as bearings for a reciprocating carrier **222**. Carrier **222** includes two arms **222***a*, **222***b* (see FIG. **14**) which are disposed in space parallel relation to each other and are interconnected by a cross piece **222***c*. Arm **222***a* carries a pivoted thread-engaging nose **222***d* on the forward end thereof which is pivoted on the arm **222***a* at pivot **222***e*, as will be subsequently described in conjunction with FIGS. **18** and **19**, pivoted thread-engaging nose **222***d* swings through a downward arc to manipulate the selected thread (i.e., thread T_2) into a position for transfer to mechanism **218** on the approaching lay and carrier assembly **40**, **70**, **72**. Arm **222***b* of carrier **222** terminates in a curved nose **222***f* which overlies the selected thread and coacts with the pivoted nose **222***d* in orienting the selected thread. The pivoted nose **222***d* is retained in its upstanding position by pull link **222***g* which has its forward end pivotally connected to the nose **222***d* at **222***h* and is operatively connected at its rearward end (after passing through guidepost **222***i*) to a biasing spring **222***j*. As may be appreciated best by progressively inspecting FIGS. **18** and **19**, as the carrier **222** is moved forwardly on breastbeam beam **28** in the direction of the approaching lay and carrier assemblies (to the right in FIGS. **18** and **19**), the pull link **222***g* will swing the pivoted nose **222***d* in the clockwise direction about pivot **222***e* for the desired thread-orienting function in conjunction with the nose **222***f*.

The carrier **220** is reciprocated through its forward stroke to present the selected thread to the mechanisms **218** by a reciprocating drive which includes a rocker shaft **224** journaled on pillow block **226** on the end of the breast beam **38** contiguous to the side frame member **34**. The rocker shaft **224** terminates in an offset arm **224***a* which is coupled via pivoted link **228** and connecting pin **230** to the carrier **222**. As seen best in FIG. **2**, at its extremity remote from offset arm **224***a*, the rocker shaft **224** carries a slotted crank arm **232**. Rocking motion is imparted to the crank arm **232** from a double arm follower lever **234** which is pivoted on the side frame **34** at **236**. The forwardly projecting arm **234***a* of the follower lever **234** carries a pin to a roller **234***b* which rides in the slot in the crank arm **232** while the rearwardly projecting arm **234***c* rides on cam **238** on crankshaft **64**. Thus, at the requisite time in the operating cycle, carrier **222** is thrust toward the approaching transfer mechanism **218** against the bias of spring **222***j* for the required thread-orienting function.

The transfer mechanism **218** include a temporary holding device **240**, **242** which picks up the presented thread and holds the same until picked up by the first carrier. The temporary holding device includes a stationary abutment **240** which provides a reaction surface against which the selected thread is pressed by an elastomeric holding head **242**. The abutment **240** is carried on a baseplate **244** which is fixed to the carrier assembly **70** at right angles to the end plate **48** of the lay **40**. Extending lengthwise of the baseplate **244** and at right angles to the end plate **48** is a mounting bar **246** for the holding head **242** which mounting bar is slidably mounted on appropriate guide blocks **248** to **250**. A spring **252** is interposed between the guide block **250** and an adjustable collar **254** on the mounting bar **246** to normally bias the elastomeric holding head **242** against the relatively stationary abutment **240**. The mounting bar **246** projects beyond the baseplate **244** in the direction of the breastbeam **38** and carries a pivoted latch **256** which normally bears against the leading edge **244***a* of the baseplate **244** to maintain holding head **242** in a clearance position spaced from abutment **240** against the bias of spring **252**. As seen in FIGS. **16–17**, when the thread has been laid between the abutment **240** and the holding head **242**, the pivoted latch **256** is engaged by the adjacent upper corner of the breastbeam **38** to clear the latch **256** relative to the edge **244***a* of the baseplate thereby permitting the holding head **242** to grip the thread against the stationary abutment **240**. After the lay **40** beats the previously picked filling into the fell of the cloth and begins its return to the retracted position, the rearwardly projecting end **246***a* of the mounting bar **246** (see FIGS. **14–15**) will engage stop **258** which projects inwardly from the adjacent side frame member **34** to displace the mounting bar **246** into a position wherein the pivoted latch **256** drops by gravity into the engaged position with the leading edge **244***a* of the baseplate **244**, thereupon, the elastomeric holding head **242** is once again in the open position to receive the next thread pick.

Once a selected thread has been picked for filling and is temporarily held by the holding members **240**, **242**, such thread is cut off from the previous fill completed with that thread. The cut and held thread is then picked up by the first carrier **74** for the next fill. Specifically, a cutting mechanism is mounted on the baseplate **244** and includes a pair of spaced stationary cutting blades **260**, **262** and a pivoted cutting blade **264** which is operative therebetween. The pivoted cutting blade **264** is mounted on the baseplate **244** at pivot **266** (see FIG. **15**) and is normally biased to an open or clearance position relative to the stationary blades **260**, **262** by spring **268**. Aligned with the pivoted blade **264** and projecting forwardly thereof in the direction of the breastbeam **38** is a knife actuator bar **270** which is mounted on the baseplate for reciprocal movement on guide blocks **272**, **274**. Fixed to the breastbeam in alignment with the knife actuator bar **270** is an actuator abutment **276** which contacts the knife actuator bar **270** at the appropriate time in the operating cycle. Thus, as the lay and carrier assemblies **40**, **70**, **72** approach the breastbeam, the selected thread is not only positioned and temporarily held by holding members **240**, **242**, but is also positioned between pivoted knife blade **264** and the stationary knife blade **260**, **262**. Abutment **276** is positioned such that after firm grasping of the selected thread by holding members **240**, **242**, the final portion of the beating stroke will cause actuator bar **270** to swing the pivoted blade **264** in the counterclockwise direction from the position illustrated in FIGS. **14** and **15** to the positions illustrated in FIGS. **16** and **17** thereby cutting off the selected thread from the previous fill made with that thread. As the lay **40** moves away from the breastbeam **38** after making the new pick and beating the previous pick, the spring **268** once again returns the blade **264** to the open position, driving the actuator bar **270** back to the position illustrated in FIGS. **14** and **15**.

With the lay **40** in the closed position illustrated in the FIGS. **16** and **17**, the thread which is selected for the pick has been cut off by cutters **262**, **264**, is temporarily held by hold-

ing members 240, 242 and is finally in position for presentation to the first carrier 74 upon transfer from the temporary holding members. Thereupon, the first carrier 74 traverses its half of the loom to present the leading end of the selected thread to the second carrier 76 at the medial pick-transfer location. This is achieved in this illustrative embodiment by the provision of a hooked needle 278 which is journaled by its shaft 278*a* on the end plate 48. The hooked end 278*b* of the needle 278 rocks from the position illustrated in the full lines in FIGS. 16 and 17 to the position illustrated by the dotted lines in FIG. 17 (corresponding to the position shown in FIGS. 14 and 15) to lift the selected thread from beneath the presenting fingers 222*d*, 222*f* and hold the same in the vertical position (shown by the dotted lines in FIG. 17 for the selected thread T_2). Thus, as the first carrier 74 is driven forward beneath the hooked-shaped needle 278*b* after the same has swung to the clearance position illustrated in FIGS. 14 and 15, the selected thread is oriented to enter the open mouth 190 and then the restricted throat or neck 190*a* of the first carrier 74, as previously described.

Drive is imparted to the hooked-shaped needle 278 for presentation of the selected thread to the first carrier by the mechanisms seen in FIGS. 2 and 3 which include a subframe 280 fixed to the frame of the first carrier assembly 70 at a location removed from the hooked-shaped needle 278. The subframe 280 supports a vertically reciprocable rack 282 which engages a pinion 284 at its upper end. The pinion 284 is on a shaft 286 which is journaled on subframe 280 which shaft carries a driving sprocket 288 connected via a chain 290 to driven sprocket 292 (see FIGS. 15–17) on needle shaft 278*a*. At its lower end, rack 282 carries a follower 294 which rides in cam track 296 fixed to the side frame member 34 by bracket 298. The development of the track 296*a* of the fixed cam member 296 is selected such that as the lay and carrier assemblies 40, 70 begin to retract from the breastbeam 38, the requisite upward motion is imparted to rack 282 to rock the hooked-shaped needle 278 to complete the thread presentation for the first carrier, as seen best by the full unbroken lines in FIG. 17.

Having completed the detailed description of the essential mechanism incorporated in the loom 30, there now follows in conjunction with FIGS. 22–25 inclusive a description of a typical sequence of operations with the present loom:

In the FIG. 22 position, the lay is in its beating position having just beat a pick into the fell formed by the ends E of the cloth C. The first and second carriers 74, 76 are at their respective retracted starting positions outwardly of the opposite sides of the weaving section of the loom in position for the making of the next pick of the filling of the weft F which is to be laid into the fell during the next beating stroke. As may be appreciated by progressively comparing FIGS. 22 and 23, and as indicated by the directional arrows in FIG. 23, the rocking assembly of the lay 40 and the first and second carrier mechanisms 70, 72 is starting to move through the return stroke from the beating position (shown in detail in FIGS. 1, 16, 17). As seen in FIG. 22, the last pick beat into the fell corresponded to thread T_1 while the previous pick was from thread T_2. In FIG. 22, there is illustrated the start of the sequence by which thread T_2 becomes the next pick, as heretofore described for illustrative purposes. By the sequential operation of the described mechanisms thread-selection finger 164 for thread T_2 is lowered and reciprocating carrier 222 of the thread-orienting mechanism places thread T_2 between the temporary holding members 240, 242. When so held by the temporary holding members 240, 242, the thread T_2 is cut off from the previous fill employing that thread by the coacting stationary and movable cutters 260, 262, and 264. With the thread T_2 held by the temporary holding members 240, 242, and cut away from the previous fill employing that thread, the hooked-shaped lifting needle 278 engages thread T_2 intermediate holding members 240, 242 and the carrier 222. Thereupon, the first carrier 74, advancing under control of rapier 80, receives the picked thread T_2 which held in a vertical orientation between the holding member 240, 242 and the needle 278 for engagement by the coacting carrier jaws 192, 194 of the first carrier 74, as described in conjunction with FIGS. 7–13 inclusive. While the first carrier 74 is in its retracted starting position and during its initial traverse toward the central weaving section of the loom and until the picked thread is engaged, the fixed cam 200 is operative through cam follower 202 to maintain the carrier jaws 192, 194 in the open position. As the cam follower 202 moves from beneath the overlying fixed cam 200, the coacting first carrier jaws 192, 194 close on the thread under the influence of the carrier spring 198 and the leading end of the picked thread T_2 is firmly gripped for advance toward the medial pick-transfer location. The initial advance of the first carrier from the FIG. 22 position to substantially that shown in FIG. 23 is effective to pull the free end or tail of the picked thread T_2 from the temporary holding members 240, 242. As shown diagrammatically in FIG. 23, and as indicated by the directional arrows, the first and second carriers 74, 76 move toward each other for the medial thread transfer function. It will, of course, be appreciated that during such motion, the rocking assembly of the lay 40 and the first and second carrier mechanisms 70, 72 are moving through the return stroke. During such return motion, a number of interrelated functions occur including movement of the movable cutter 264 away from the stationary cutters 260, 262, return of the thread carrier 222 to its starting position, opening of the temporary holding members 240, 242, return of the hooked-shaped needle 278 to its starting position; and of course, the thread-selection functions for the next pick go forward.

In the simplified and diagrammatic showing of FIG. 24, the assembly of the lay 40 and the first and second carriers 70, 72 have completed the return stroke and are at the maximum displacement from the fell of the cloth C while the rapiers 80, 80′ have brought the first and second carriers 74, 76 into the medial pick-transfer location wherein the carriers 74, 76 coact as illustrated and described in conjunction with FIGS. 12 and 13 to transfer the leading end of the picked thread T_2 from between the jaws 192, 194 of the first carrier 74 to between the jaws 206, 208 of the second carrier 76. In this illustrative embodiment, the medial transfer takes place as the result of the coaction between and orientation of two sets of closed jaws, 192, 194 and 206, 208, with the leading end of the picked thread T_2 being forced between the hook 206*a* and the finger 208*a*. Although this thread transfer technique has been found perfectly satisfactory for a number of applications, there will be described hereinafter a further technique for thread transfer which has been found to be particularly advantageous when employing heavier filling materials.

Next, by referring to FIGS. 24 and 25, it will be seen that the return stroke of the first and second carriers 74, 76 is effective to complete the pick employing thread T_2 as the filling. Concurrently, as indicated by the directional arrow in FIG. 25, the assembly 40, 70, 72 moves forwardly toward the fell of the cloth through the next beating stroke such that the picked filling will be beat into the fell of the cloth when the loom returns to the position illustrated diagrammatically in FIG. 22 and actually in FIGS. 1, 16 and 17. As the beating stroke is being completed, and for the illustrative condition shown in FIG. 25, the thread carrier 222 has begun its coaction with the thread-selection finger 164 for filling thread T_4 which is to be the next pick as determined by the punchings of the tape 128 of the filling-selector mechanism 126. Of course, in the FIG. 25 position, the temporary holding members 240, 242 are in the open position to receive the selected thread T_4 and likewise the movable cutter 264 is in its clearance position relative to the stationary cutters 260, 262 such that after the selected thread T_4 is held it is automatically positioned for cutoff from the previous utilization thereof as a filling.

The showings in FIGS. 22–25 is on a greatly simplified and exaggerated scale and is intended to supplement the detailed showing in the previous figures and their accompanying description. Further variations in loom details will be readily apparent to those skilled in this art.

In a typical working loom, provision must be made for binding the opposite selvages of the cloth C as it is woven. Various mechanisms are suitable for twisting a plurality of binding threads along the opposite selvages of the cloth as the latter is formed. Referring to FIGS. **1–3**, **26** and **27**, there is illustrated a represented selvage-binding mechanism which includes identical right and left selvage-binding mechanisms **300**, **300'** mounted respectively on the side frame members **34**, **36** toward the rear of the loom. Since the selvage-binding mechanisms **300**, **300'** are of identical construction and function, except for their orientation with respect to the right and left selvages of the cloth C, it will suffice to only describe mechanism **300** which is seen to be mounted on the side frame member **34** by mounting bracket **302**. Bracket **302** provides an inclined platform extending downwardly and forwardly, as seen in FIG. **2**. Bracket or platform **302** is provided with bearings **304**, **306** which journal a combined turntable shaft and hollow feed tube **308**. At its rearward end, tube **308** carries a turntable **310** having mounted thereon two spindles **312**, **314** receiving spools of the selvage-binding thread **316**, **317**. The selvage threads S_1 and S_2 pass from the spools **316**, **317** into the hollow feed tube **308** and egress from the tube at exit openings **308***a* close to but spaced rearwardly from the forward end of tube **308**. On the forward end of tube **308**, there is mounted two forwardly projecting thread-twisting tubes **318**, **320**. The thread-twisting tubes **318**, **320** cross over each other intermediate their ends and have their trailing ends **318***a*, **320***a* fixed to the forward end of feed tube **308** and position to receive the selvage-binding threads S_1, S_2. Their forward ends **318***b*, **320***b* are positioned to deliver the selvage-binding thread S_1, S_2 along the opposite selvages of the cloth being woven, with the selvage-binding threads being twisted about successive picks or fills F. The twisted binding threads S_1, S_2 define the opposite margins of the woven cloth and serve in relation to the filling much in the same way as the warp of the cloth proper. It is, of course, understood that the selvages and the selvage-binding threads S_1, S_2, are cut away when the cloth is utilized. The selvage-binding mechanisms **300**, **300'** are subject to a latitude of modification, change and substitution; and an alternate arrangement which finds useful application will be subsequently described in conjunction with FIGS. **35–37** inclusive.

Some details of the loom have not been illustrated, while others are subject to a latitude of modification, change and substitution. Details such as drives, guides, etc., require only a passing comment. For example, in FIGS. **20** and **21** there is illustrated in detail a typical guiding and tensioning arrangement for the filling threads providing the successive picks or fills for the cloth. In the illustrative showing of the machine, the filling thread supply (see FIG. **3**) is taken from cones, such as indicated at **324**, mounted on a cone spindle **326** supported with a thread-dispensing box or housing **328**. The inner sidewall of the housing **328** is provided with an appropriate number of exit holes **328***a* for the corresponding filling threads which threads pass through the thread-guiding and tensioning arrangement, generally designated by the reference numeral **330** and seen detail in FIGS. **21** and **22**. The thread-tensioning arrangements **330** is mounted on an appropriate bracket **332** fixed to the inner side of the housing **328** and includes a series of upstanding posts **334** each of which has mounted thereon a resilient thread guide **336**. The resilient thread guide **336** includes an intermediate coil spring **336***a* which is mounted on a pin **338**, an upper and forwardly directed arm **336***b* which terminates in a thread guide or eye **336***c* and a lower and forwardly directed arm **336***d* which likewise terminates in a thread guide or eye **336***e*. Mounted on pin **338** inwardly of guide **336** is a thread-guide-tensioning spring **340** which has an intermediate coil spring **340***a* and has one arm **340***b* hooked over thread guide arm **336***b* and its other arm **340***c* engaging post **334** to appropriately anchor spring **340**. The thread T passes from cone **324** about an appropriate guide, through exit opening **328***a*, through eye **336***c* and then through eye **336***e* and then to the eye in the forward end of the corresponding thread selection finger **160**. The spring **340** normally biases the thread guide and tensioning arrangement in the counterclosewise direction about mounting pin **338** to exert the necessary back tension on the corresponding filling thread. Alternative or additional thread-tensioning arrangements may be employed on the loom wherever required to facilitate loom operation, as is generally understood by those skilled in the art.

Reference will now be made to FIGS. **28** to **34** for description of an alternate arrangement which may be employed in the loom for transferring a pick or filling thread T at the medial transfer location from the first carrier to the second carrier of the loom. The alternate arrangement will be described only to the extent necessary for an understanding of this particular feature, it being appreciated that the remaining details of the loom are identical to that described in the principle embodiment. Accordingly, identical reference will be employed wherever possible and reference numerals as a part of a "400" series will be employed for modified components of the loom. As seen in FIG. **28**, the modified loom still includes two rapiers **80**, **80'** which reciprocate at right angles to the opposite side frame members **34**, **36** rearwardly of the breast-beam **38** of the loom. The rapiers **80**, **80'** are part of the lay **40** and first and second carrier mechanisms **70**, **72** of the loom which move between the retracted position illustrated by the full lines in FIG. **28** and the operative or beating position shown by the full lines in FIG. **28**. In this modification, the first rapier **80** carries a modified first carrier **400** (shown in detail in FIG. **31**) while the second rapier **80'** carries a modified second thread carrier **402** (shown in detail in FIG. **32**). The coaction between the modified first and second thread carriers **400**, **402** at the medial transfer location is progressively illustrated in FIGS. **33** and **34**. The first carrier **400** is actuated to its open position to receive a carrier thread contiguous to the right side frame member **34** of the loom by a stationary side cam **404** which is in a general vertical orientation as compared to the cam **200**. A comparable side cam **406** is provided contiguous to the left side frame member **36** and except for its vertical orientation functions like the cam **212** illustrated in the principle embodiment. Cam **404** serves to open the first carrier to receive a filling thread while cam **406** serves to open the second carrier after the fill has been completed to release the picked filling thread. Additionally, there is provided contiguous to the medial transfer location, a third cam **408** which coacts with the second carrier **402**, as shown in detail in FIGS. **33** and **34**, to open the second carrier to receive a picked filling thread from the first carrier at the medial transfer location. Cam **408** is mounted on the reed cap **46** of the lay **40** and includes a plurality of depending fingers **408***a* which projects down between the ends E of the cloth, with the fingers being interconnected by a transverse bridge **408***b*. The cam fingers **408***a* fit between the ends E as the lay moves through its beating stroke (compare the full and broken lines shown in FIG. **30**.) In the retracted position of the lay **40**, the depending fingers **408***a* of the cam **408** are positioned for actuating the second carrier **402**, as it will be subsequently described, while in the beating or operative position of the lay **40** (as shown by the dot-dash lines in FIG. **30**), the fingers **408***a* are in a clearance position above the woven cloth C wherein they do not interfere with the vertical reeds **42** beating a pick into the cloth.

Reference will now be made to FIG. **31** for a description of the first carrier **400** which is mounted on the rapier **80**. The first carrier **400** includes a carrier body **410** which is fixed to the rapier **80** and is formed at its forward end with a laterally flared open mouth **412** which gradually merges into a reduced thread-receiving throat **412***a*. The open mouth **412** and its throat **412***a* are defined by opposed lips **410***a*, **410***b* formed on the carrier body **410** which provide confronting thread-guiding surfaces for directing the picked thread into the throat **412***a*. Extending along one side of the thread-receiving throat **412***a* and rearwardly within the body **410** is a stationary carrier jaw **414** which is fixed, as by rivets, to the carrier body **410**. Extending at the opposite side of the thread-receiving throat

412 and rearwardly of the body 410 is a movable carrier jaw 416 which is pivoted at pin 418 for movement into and out of closing relation to the stationary carrier jaw 414. Rearwardly of the pin 418, there is provided a fixed guide pin 420 which is accommodated within an elongated guide slot 422 formed in the pivoted carrier jaw 416. A flat leaf spring 423 bears against the rearwardly projecting arm 416*a* of jaw 416 and normally biases jaw 416 against jaw 414. An arm 416*a* terminates in an enlarged head 416*b* which is engaged by a cam follower 424 which is pivoted at 426 and includes a follower head 424*a* projecting through a cutout 410*c* formed in the adjacent side of the carrier body 410.

As seen in FIG. 28, it is at this side that cam 404 is arranged, with cam 404 serving to hold the movable jaw 416 of the first carrier 410 in the open position when the first carrier is in its retracted starting position outwardly of the side frame member 34 of the loom and while the first carrier moves through the location in which it picks up the thread for the selected filling. Thereupon, cam follower 424 passes out of contact with cam 404 and the closed carrier jaws 414, 416 serve to advance the picked thread to the medial pick-transfer location.

As seen in FIG. 32, the second carrier 402 which is mounted in rapier 80' includes a carrier body 428 to which is fixed, as by rivets, a forwardly projecting fixed carrier jaw 430, the leading end of which terminates in a rearwardly directed thread-engaging hook 430*a*. Extending next to the fixed carrier jaw 430 is a movable carrier jaw 432 which is pivoted at pivot pin 434 and arranged such that its leading end, serving as a finger 432*a*, coacts with hook 430*a* for the thread retention function. The movable carrier 432 includes a rearwardly projecting arm 432*b* which terminates in an enlarged head 432*c* which is engaged by leaf spring 436 which normally biases finger 432*a* against hook 430*a*. Rearwardly of the jaws 430, 432 is a cam follower 438 which is pivoted at 440 and includes a follower head 438*a* projecting to one side of the carrier body 428 to be engaged by the cam 408 at the medial pick-transfer location and to be also engaged by the side cam 406. Specifically, at the medial transfer location, cam 408 contacts follower 438 to swing finger 432*a* away from hook 430*a* to open the second carrier to receive the advancing filling thread on carrier 400. As the second carrier 402 moves through its return traverse from the medial transfer location to its starting position outwardly of the weaving section of the loom, cam follower 438 moves out of contact with cam 408, virtually at the beginning of the return stroke thereby permitting jaws 430, 432 to close under the influence of spring 436 to pick up the picked thread to complete the transfer from the first carrier. The position shown in FIG. 34 for the first and second carriers 400 and 402 is just prior to disengagement of cam follower 438 from cam 408 and closing jaws 430, 432. When the second carrier moves outwardly of the loom to bring the cam follower 438 into contact with the side cam 406, jaws 430, 432 are again engaged to release the picked thread which has been laid into the fell of the cloth. The remainder of the loom operates as previously described.

Referring now to FIGS. 35–37 inclusive, there is shown a modified selvage-binding mechanism, generally designated by the reference numeral 441, which may be substituted for that described and illustrated in connection with FIGS. 26 and 27. Once again the selvage-binding mechanisms include identical right and left units mounted respectively on the left and right side frame members 34, 36 of the loom and rearwardly thereof outwardly of the weaving section. Since the modified selvage-binding mechanisms for the left and right sides of the loom are of identical construction, it will suffice to describe only one such mechanism in detail. The selvage-binding mechanism 441 includes a combined turntable shaft and hollow feed tube 442 which is similar in construction and function to the tube 308 and carries at its rearward end a turntable and two spindles for the selvage-binding threads S_1 and S_2 as illustrated in detail in FIGS. 1 and 26. Contiguous to its forward end the tube is provided with opposed egress openings 442*a*, 442*b* for the threads S_1 and S_2. Fixed to the forward end 442*c* of tube 442 is a mounting block 444 for thread-twisting tubes 446, 448 which respectively receive the threads S_1, S_2. Mounting block 444 is provided with the through bores 444*a* and 444*b* which are shaped to permit the tubes 446, 448 to move toward and away from each other as they are rotated with the feed tube 442. Thread-twisting tube 446 is mounted on block 444 at bore 444*a* by spaced collars 446*a*, 446*b*; and in a similar fashion tube 448 is mounted in through bore 444*b* by spaced collars 448*a* and 448*b*. On the rearwardly projecting ends of tubes 446, 448 immediately behind the mounting collars 446*a*, 448*a* is a coil spring 450 which normally biases the twisting tubes 446, 448 to the outwardly diverging position illustrated in these figures. Disposed forwardly of the mounting arrangement for the twisting tubes and surrounding the same is a camming member 452 which is provided with an elliptical cutout 452*a* having its major axis extending vertically. The camming member 452 is mounted on the frame of the machine at any convenient location by bracket 454. The cutout 452*a* is configured to cam the thread-twisting tubes 446, 448 from the diverging position illustrated by the full lines in these figures to the converged and substantially parallel position illustrated by the dot-dash lines such that the thread-twisting tubes substantially follow the movement of the warped threads in response to opening and closing of the shed. This facilitates operation of the modified thread-binding mechanism illustrated in FIGS. 35–37 which is effective to produce a binding selvage of the type generally illustrated and described in conjunction with FIG. 27.

Provision is made with the selvage-binding mechanisms 300, 300' illustrated in FIGS. 26 and 27 or with the modified selvage-binding mechanisms 441 in FIGS. 35 to 37 for imparting drive to such mechanisms from the main shaft 58 of the machine. Referring specifically to FIG. 2, it will be seen that the turntable shaft 308 (and the comparable turntable shaft 442) is connected via appropriate chains and sprockets 454 to a Geneva shaft 456 which is journaled upon the machine frame 32 at a location rearwardly of and directed toward the main shaft 48. At its forward end, Geneva shaft 456 carries radially projecting arms 458 which are engaged by a drive segment 460 fixed to shaft 58. The chain and sprockets 454 are selected such that the shaft 456 has a two to one gearing ratio relative to turntable shaft 308 (or comparable turntable shaft 442). Thus, a quarter turn of the Geneva shaft corresponds to a half turn of the turntable shaft 308 and a complete reversal of the relative positions of the selvage threads S_1, S_2. The timing for this illustrative embodiment is such that two filling threads F are placed into the cloth between each twist imparted to the selvage threads S_1, S_2. Obviously, other timings are contemplated and can be readily achieved as is generally understood by those skilled in the art.

From the foregoing, it will be appreciated that there has been provided in accordance with the present invention improved shuttleless loom mechanisms suitable for converting existing looms or for the manufacture of new looms. The loom mechanisms are such that a wide variety of patterns may be created and various types of fillings may be utilized with the loom rendering the same highly versatile for the creation of a wide variety of fabrics of different textures and patterns. The control of the loom is perfectly compatible with existing control mechanisms and changeover of filling threads is readily accomplished. Additionally, the loom exhibits all of the attributes and advantages of a shuttleless loom and is capable of operation over long periods of time without the necessity of replacement of the filling threads.

A latitude of modification, change and substitution is intended in the foregoing disclosure and accordingly it is appropriate that the appended claims be construed broadly and in a manner consistent with the spirit and scope of the present invention.

I claim:

1. In a shuttleless cloth-weaving loom including a frame having a weaving section and shed-forming means in said

weaving section having plural warp threads converging at a fell into which successive filling threads are beat to form the cloth, the improvement comprising a combined lay and carrier assembly movable through a beating stroke and selectively presenting picked threads in said shed for beating into said fell, said assembly including first and second carriers movable from respective first and second clearance positions at the opposite sides of said weaving section to a medial pick-transfer location relative to said weaving section, said first and second carriers each including cooperating thread-gripping jaws and means normally biasing said jaws into a closed position relative to each other, first jaw-actuating means operatively arranged relative to said first carrier when in said first clearance position at one side of said weaving section for opening its thread-gripping jaws to receive a presented filling thread for advance to said pick-transfer location, filling-selector and presenting mechanisms at said one side for presenting a selected filling thread to the opened thread-gripping jaws of said first carrier, the open thread-gripping jaws of said first carrier closing in response to movement of said first carrier from said clearance position toward said pick-transfer location, the thread-gripping jaws of said first and second carriers being constructed and arranged to coact with each other in said pick-transfer location to transfer the filling thread from said first carrier to said second carrier, the thread-gripping jaws of said second carrier being effective to complete the lay of the filling thread into said shed as said second carrier moves from said pick-transfer location to said second clearance position, second jaw-actuating means operatively arranged relative to said second carrier when in said second clearance position at the other side of said weaving section for opening its thread-gripping jaws to release the filling thread for beating into said fell, coordinated drive means for moving said assembly through said beating stroke and for moving said first and second carriers relative to each other in timed relation such as to progressively weave said cloth and means disposed substantially at said pick-transfer location for opening the closed jaws of said second carrier as said carriers approach said pick-transfer location, such that the open jaws of said second carrier will receive the picked filling thread from said first carrier.

2. A loom according to claim 1 wherein said means at said pick-transfer location includes a cam on said assembly projecting into said shed.

3. In a shuttleless cloth-weaving loom including a frame having a weaving section and shed-forming means in said weaving section having plural warp threads converging at a fell into which successive filling threads are beat to form the cloth, the improvement comprising a combined lay and carrier assembly movable through a beating stroke and selectively presenting picked threads in said shed for beating into said fell, said assembly including first and second carriers movable from respective first and second clearance positions at the opposite sides of said weaving section to a medial pick-transfer location relative to said weaving section, said first and second carriers each including cooperating thread-gripping jaws and means normally biasing said jaws into a closed position relative to each other, first jaw-actuating means operatively arranged relative to said first carrier when in said first clearance position at one side of said weaving section for opening its thread-gripping jaws to receive a presented filling thread for advance to said pick-transfer location, filling-selector and presenting mechanisms at said one side for presenting a selected filling thread to the opened thread-gripping jaws of said first carrier, the open thread-gripping jaws of said first carrier closing in response to movement of said first carrier from said clearance position toward said pick-transfer location, the thread-gripping jaws of said first and second carriers being constructed and arranged to coact with each other in said pick-transfer location to transfer the filling thread from said first carrier to said second carrier, the thread-gripping jaws of said second carrier being effective to complete the lay of the filling thread into said shed as said second carrier moves from said pick-transfer location to said second clearance position, second jaw-actuating means operatively arranged relative to said second carrier when in said second clearance position at the other side of said weaving section for opening its thread-gripping jaws to release the filling thread for beating into said fell, coordinated drive means for moving said assembly through said beating stroke and for moving said first and second carriers relative to each other in timed relation such as to progressively weave said cloth and said filling-selector and presenting mechanisms including plural thread-selection fingers adapted to be moved by a tape control for initially orienting a selected filling thread for presentation to said first carrier, temporary holding means for receiving and gripping the selected filling thread, transfer means movable relative to said thread-selection fingers and operable to place a selected filling thread in said temporary holding means, a thread cutter operable after the selected filling thread is held by said temporary holding means for cutting the selected and held filling thread from the previous fill formed with such thread and means for orienting the selected, held and cut filling thread to be engaged within the open thread-gripping jaws of said first carrier.

4. A loom according to claim 3 wherein said temporary holding means includes a stationary abutment providing a reaction surface against which the selected filling thread may be pressed, an elastomeric holding head movable relative to said abutment, a spring normally biasing said holding head against said abutment and latch means for maintaining said holding head in spaced relation to said abutment such that the selected filling thread may be engaged by said temporary holding means, said latch means being operable in response to movement of said combined lay and carrier assembly through said beating stroke.

5. A loom according to claim 3 wherein said thread-cutter includes a cutting blade and blade-actuating means operable in response to movement of said combined lay and carrier assembly through said beating stroke.

6. A loom according to claim 3 wherein the orienting means includes a thread lifter cooperating with said temporary holding means for positioning the selected held and cut filling thread in a substantially vertical attitude for engagement by said first carrier.

7. In a shuttleless cloth-weaving loom including a frame having a breastbeam and a weaving section and shed-forming means in said weaving section having plural warp threads converging at a fell into which successive filling threads are beat to form the cloth, the improvement comprising a combined lay and carrier assembly movable through a beating stroke relative to said breastbeam and selectively presenting selected filling threads in said shed for beating into said fell, said assembly including first and second carriers movable from respective first and second clearance positions at the opposite sides of said weaving section to a medial pick-transfer location relative to said weaving section, said first and second carriers each including cooperating thread-gripping jaws and means normally biasing said jaws into a closed position relative to each other, first jaw-actuating means operatively arranged relative to said first carrier when in said first clearance position at one side of said weaving section for opening its thread-gripping jaws to receive a presented filling thread for advance to said pick-transfer location, filling-selector and presenting mechanisms at said one side for presenting a selected filling thread in substantially vertical orientation to the opened thread-gripping jaws of said first carrier, said mechanisms including temporary holding means contiguous to said one side of said weaving section for temporarily gripping and holding a selected filling thread, a cutter for cutting the selected and held filling thread from the previous fill formed with such thread and thread-lifting means for engaging the held filling thread and imparting a substantially vertical orientation thereto, the open thread-gripping jaws of said first carrier closing in response to movement of said first carrier from said clearance position toward said pick-transfer location, the

thread-gripping jaws of said first and second carriers being constructed and arranged to coact with each other in said pick-transfer location to transfer the picked filling thread from said first carrier to said second carrier, the thread-gripping jaws of said second carrier being effective to complete the lay of the picked filling thread into said shed as said second carrier moves from said pick-transfer location to said second clearance position, second jaw-actuating means operatively arranged relative to said second carrier when in said second clearance position at the other side of said weaving section for opening its thread-gripping jaws to release the picked filling thread for beating into said fell and coordinated drive means for moving said assembly through said beating stroke and for moving said first and second carriers relative to each other in timed relation such as to progressively weave said cloth.

8. A loom according to claim 7 wherein the thread-gripping jaws of said first and second carriers are closed at said pick-transfer location and include coacting means which cooperate with each other at said pick-transfer location for transferring a picked filling thread from the closed jaws of said first carrier to the closed jaws of said second carrier.

9. A loom according to claim 7 including a comblike cam disposed at said pick-transfer location for opening the closed jaws of said second carrier as said carriers approach said pick-transfer location, such that the open jaws of said second carrier will receive the picked filling thread from said first carrier.

10. A loom according to claim 9 wherein said first and second carriers include first and second cam followers operatively connected to the respective jaws thereof and wherein said first and second jaw-actuating means include first and second cams fixed to said assembly at the opposite sides of said weaving section for opening said carriers when disposed outwardly of the opposite sides of said weaving section.

11. In a shuttleless cloth-weaving loom including a frame having a breastbeam and a weaving section and shed-forming means in said weaving section having plural warp threads converging at a fell into which successive filling threads are beat to form the cloth, the improvement comprising a combined lay and carrier assembly movable through a beating stroke relative to said breastbeam and selectively presenting picked filling threads in said shed for beating into said fell, said assembly including first and second carriers movable from respective first and second clearance positions at the opposite sides of said weaving section to an intermediate pick-transfer location relative to said weaving section, said first and second carriers each including cooperating thread-gripping jaws and means normally biasing said jaws into a closed position relative to each other, first jaw-actuating means operatively arranged relative to said first carrier when in said first clearance position at one side of said weaving section for opening its thread-gripping jaws to receive a presented filling thread for advance to said pick-transfer location, filling-selector and presenting mechanisms at said one side for orienting and presenting a selected filling thread to the opened thread-gripping jaws of said first carrier, said mechanisms including temporary holding means contiguous to said one side of said weaving section for temporarily gripping and holding a selected filling thread, a cutter for cutting the selected and held filling thread from the previous fill formed with such thread and thread-lifting means for engaging the held filling thread and imparting a prescribed orientation thereto, the open thread-gripping jaws of said first carrier closing in response to movement of said first carrier from said clearance position toward said pick-transfer location, the thread-gripping jaws of said first and second carriers being constructed and arranged to coact with each other in said pick-transfer location to transfer the picked filling thread from said first carrier to said second carrier, the thread-gripping jaws of said second carrier being effective to complete the lay of the picked filling thread into said shed as said second carrier moves from said pick-transfer location to said second clearance position, second jaw-actuating means operatively arranged relative to said second carrier when in said second clearance position at the other side of said weaving section for opening its thread-gripping jaws to release the picked filling thread for beating into said fell and coordinated drive means for moving said assembly through said beating stroke and for moving said first and second carriers relative to each other in timed relation such as to progressively weave said cloth.

12. A loom according to claim 11 wherein the thread-gripping jaws of said first and second carriers are closed at said pick-transfer location and include coacting means which cooperate with each other at said pick-transfer location for transferring a picked filling thread from the closed jaws of said first carrier to the closed jaws of said second carrier.

13. A loom according to claim 11 including a comblike cam disposed at said pick-transfer location for opening the closed jaws of said second carrier as said carriers approach said pick-transfer location such that the open jaws of said second carrier will receive the picked filling thread from said first carrier.

14. A loom according to claim 13 wherein said first and second carriers include first and second cam followers operatively connected to the respective jaws thereof and wherein said first and second jaw-actuating means include first and second cams fixed to said assembly at the opposite sides of said weaving section for opening said carriers when disposed outwardly of the opposite sides of said weaving section.

15. A loom according to claim 11 wherein said filling-selector and presenting mechanisms include plural thread-selection fingers adapted to be moved by a tape control for initially orienting a selected filling thread for presentation to said first carrier temporary holding means for receiving and gripping the selected filling thread, transfer means movable relative to said thread-selection fingers and operable to place a selected filling thread in said temporary holding means, a thread cutter operable after the selected filling thread is held by said temporary holding means for cutting the selected and held filling thread from the previous fill formed with such thread and means for orienting the selected, held and cut filling thread to be engaged within the open thread-gripping jaws of said first carrier.

16. A loom according to claim 15 wherein said temporary holding means includes a stationary abutment providing reaction surface against which the selected filling thread may be pressed, a holding head movable relative to said abutment, a spring normally biasing said holding head against said abutment and means for maintaining said holding head in spaced relation to said abutment such that the selected filling thread may be engaged by said temporary holding means, said last-named means being operable in response to movement of said combined lay and carrier assembly through said beating stroke.

17. A loom according to claim 15 wherein said thread cutter includes a cutting blade and blade-actuating means operable in response to movement of said combined lay and carrier assembly through said beating stroke.

18. A loom according to claim 15 wherein the orienting means includes a thread lifter cooperating with said temporary holding means for positioning the selected, held and cut filling thread in a substantially vertical attitude for engagement by said first carrier.